OBSERVATIONS ON SELF-FEEDING ROUGHAGES TO DAIRY COWS IN LOOSE-HOUSING

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OBSERVATIONS ON SELF-FEEDING ROUGHAGES TO DAIRY COWS IN LOOSE-HOUSING

By

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INTRODUCTION

The trend in milk production is, at the present time, toward a gradual increase in costs of production without a corresponding increase in milk return. If the present conditions persist, it would seem that the major hope of the milk producer for maintaining a reasonable margin of profit is to increase the efficiency of his operation.

It is well known that the two major items in milk production are labor and feeding costs. New labor-saving methods, such as the barn cleaner, the milking parlor, and self-feeding, in recent years, have been developed and brought into use on many farms. Labor-saving is one of the main reasons for the increased popularity of the loose-housing system, which incorporates many work simplification ideas.

As far as feeding is concerned, the importance of including good quality roughage in the ration of the dairy cow is now realized. A recent investigation by the Department of Agricultural Economics, Michigan State College (36), indicates that feed costs are lower and returns above feed costs higher on those farms where there is a

liberal use of good quality roughage and a lower concentrate feeding rate. Many Michigan dairy farmers are now producing and storing good quality roughages.

The old idea that the acids in more than 35 pounds of silage daily per cow were harmful now has been proven wrong by the experience of many farmers and by most Agricultural Experiment Stations (13). The Washington Experiment Station (2) has reported that one of their herds consumed an average of 91 pounds of silage per cow daily. It seems logical to consider that with higher silage feeding levels, it should be possible to reduce concentrate feeding rates, and to thus reduce production costs.

This study is directed towards this and other aspects of self-feeding roughages under loose-housing conditions, the objectives being:

1. To study the self-feeding of dairy cows in loose-housing with particular reference to the effect on hay consumption when silage is included in the ration.

2. To study the effect of type of roughage provided upon concentrate requirements.

3. To assess the roughage feeding losses involved under the loose-housing system when self-feeding is practiced.

4. To study the flavor of the milk produced.

5. To study the feeding habits of the cows when on different roughage rations.

REVIEW OF LITERATURE

As this research seeks to explore more than one facet of feeding dairy cows in loose-housing, it is proposed, for simplicity and convenience, to discuss the literature under the following headings: (1) feeding of dairy cows in loose-housing; (2) feeding roughages and their relationship to concentrate requirements; (3) roughage losses during storage; (4) silage flavor in milk; and (5) cattle feeding behavior. However, it will be readily appreciated that it is impossible to make a complete separation between these sections.

Feeding Dairy Cows in Loose-Housing

In what appears to be the first mention of loose-housing of dairy cattle in the literature, Fraser (8), in 1905, reported a survey made of eighteen farms using this sytem. It is stated that satisfaction was obtained when the cows were fed roughage liberally and grain according to the milk production. The unspecified amount of roughage usually was fed from a large manger in the center of the shed.

Reporting on a 3-year experiment with closed versus open stabling of dairy cows in 1913, Buckley and Lamson (3) indicated that the cost of producing milk was slightly less in the open shed than in the closed stable. By monthly weighings it was shown that the cows in the open shed made an average gain in body weight of 4.6 percent, while those in the closed stable lost 5.6 percent in body weight during the experimental period. The kinds and amounts of roughages and concentrates fed were the same for both groups. The concentrate feeding rate was not reported.

Davis (4), in 1914, recorded that cows kept in an open shed had keener appetites and consumed more roughage than those kept in a stanchion barn.

An investigation on loose-housing was carried out under the auspices of the United States Department of Agriculture and reported by Woodward, Turner, Hale, and McNulty (38) in 1918. It was shown that the cows in the open shed consumed somewhat more feed and produced slightly more milk than those kept in the closed barn. However, the increase in production, under prices then ruling, was not sufficient to offset the extra feed costs. The cows were fed all the silage and hay they would consume without waste. Body weights were not recorded.

The first detailed feeding records appear in 1935 under the authorship of Dice (5). This work showed that cows housed in the stanchion barn used 16.03 pounds of total digestible nutrients for 1 pound of butter-fat, and 0.629 pounds of total digestible nutrients for each pound of milk produced. Cows housed in an open shed consumed 14.02 pounds of total digestible nutrients per pound of butter-fat, and 0.635 pounds of total digestible nutrients for each pound of milk produced. During the 5-month trial the group in the stanchion barn each gained, on an average, 68 pounds in body weight, and the herd in the open shed, 88 pounds. The cows in the open shed were said to be more persistent producers.

By 1945, interest in loose-housing had greatly increased as, by this time, the possible savings in labor and costs were more widely recognized. Jefferson and Weaver (15) reported on a number of the advantages and disadvantages based on the experience of seventy-eight Michigan farmers. The self-feeding hay rack was particularly favored, but no indication was given of the roughage quantities used.

The work of Graves, Dawson, and Kopland (11) of the United States Department of Agriculture Experiment Station at Huntley showed that cows produced more milk and butter-fat when kept under the

loose-housing system. While on trial, the animals were permitted to feed on alfalfa hay and corn silage at will. Cows on a concentrate ration of 1 pound of concentrates to 3 pounds of milk produced approximately 19 percent more milk in the pen barn while consuming 7,296 pounds of total digestible nutrients plus pasture, as compared with 6,950 pounds of total digestible nutrients plus pasture when in the stanchion barn.. The average gain in body weight was 176 pounds in the pen barn compared with 135 pounds in the stanchion barn. Cows on a concentrate ratio of 1 pound to 9 pounds of milk produced approximately 7 percent more milk in the pen barn while consuming 9,253 pounds of total digestible nutrients, compared with 7,805 pounds in the stanchion barn. The average gain in body weight was 119 pounds in the pen barn, as compared with 41 pounds in the stanchion barn. As the cows on the limited concentrate ration did not have access to pasture, it was possible to compare their relative efficiency of concentrate utilization (Table I).

It is apparent from this study that the cows in the pen barn ate more, produced more, and gained more body weight than the cows in the stanchion barn.

Further investigations by Dice (6), reported in 1947, allowed him to postulate that apparently milk cows on full feed when in cold

TABLE I

RELATIVE EFFICIENCY OF COWS ON LIMITED CONCENTRATE RATION WHEN KEPT IN PEN AND STANCHION BARNS

Item	Pen Barn	Stanchion Barn
Total digestible nutrients	9,253	7,805
Pounds of milk produced	14,319	13,363
Pounds of TDN required per pound of milk produced	0.6462	0.5840

open housing produce adequate surplus heat over usual maintenance requirements to maintain body temperatures without using additional nutrients for that purpose. Accordingly, no higher requirements need to be allowed for under the loose-housing system. Smith, Shaw, Gilden, and Nichols (30) found that severe cold weather did not deter the cow from feeding at outside racks; however, it was emphasized that the feeding area should have no cross drafts.

Feeding Roughages and Relationship to Concentrates

Self-feeding of dairy cows was first mentioned in the literature by Hunt in the 1918 annual report of the Virginia Agricultural Experiment Station (14). This study covered the self-feeding of

roughages and concentrates. It was found that the cows consumed feed in quantities which were very much in excess of what was really required for maintenance and milk production. On the average, 41.83 pounds of corn silage and 17.3 pounds of concentrates were consumed per cow daily. The average daily milk yield was 25.6 pounds per cow. Therefore, 1 pound of concentrates was consumed for every 1.47 pounds of milk produced. No sickness was encountered and, as was to be expected, the general condition of the cows improved during the trial.

Work of a similar nature was reported by Nevans (24) in 1918 which confirmed that when all feed was self-fed, most of the cows consumed from 50 to 100 percent more net energy than the estimated requirements. From the standpoint of digestible protein, the amounts consumed were quite uneconomical.

For the remainder of the 1920's, self-feeding references are confined to swine. However, Fraser (9), in 1939, recommended self-feeding roughages to dairy cows and indicated that many farmers had already successfully adopted this system.

In 1950, Stewart (32), in a field study of practices in loose-housing, found that many milk producers did not know what their roughage consumption was. Out of thirty-six farms visited, only

three practiced self-feeding; the remainder fed roughage from mangers in the lounging area. The amount of concentrate consumed varied widely, but no attempt was made to correlate it with production.

In 1940, a 10-year Wisconsin dairy barn research project was set in motion and was reported by Witzel, Heizer, and co-workers in 1951 (37). This project was established to compare the loose-housing of dairy cattle with conventional stanchion barns. The objectives were comprehensive, studying such aspects as minimum requirements for proper housing, efficient management, quality and quantity of milk, health, feed requirements, bedding, and temperatures. Roughages were hand-fed ad libitum. The loose-housing herd cleaned up slightly more roughage and gained more body weight than the herd housed in the stanchion barn. A 9-year average of 20.4 pounds of hay and 35.8 pounds of silage, providing 16.89 pounds of total digestible nutrients, were consumed daily by the loose-housing herd. No concentrate feeding rate was stated, but, according to the total consumption, 0.86 pounds of total digestible nutrients were required per pound of 4 percent fat corrected milk. The milk produced by the herd in loose-housing consistently was found to be of high quality, and odor and flavor tests, with few exceptions, were satisfactory.

Yeck and Cleaver (41) outlined many of the modern concepts of loose-housing. Feeding requirements for 1,000-pound cows were discussed in some detail. It was suggested that where silage is fed ad libitum along with some good quality hay, 60 pounds of silage and 10 pounds of hay will be required daily for each animal. A concentrate feeding rate of 1 pound to 3 to 4 pounds of milk was coupled with this recommendation.

Blosser and his associates (2) conducted a trial in 1952 to find out the production of dairy cows when they were allowed to consume large quantities of alfalfa-grass silage and this was compared with results obtained when a very small quantity of hay plus ad libitum alfalfa-grass silage was fed. Average daily roughage consumption per cow was 100.6 pounds when cows received silage alone, and 91.0 pounds when they were also fed 5 pounds of hay daily. Concentrates were fed at the rate of 1 pound to 4 pounds of 4 percent fat corrected milk. The hay and silage group produced slightly more milk than when hay was omitted.

Porter (26), at Iowa, carried out a number of self-feeding observations with dry milk cows. Under loose-housing conditions they had access to good alfalfa hay,, corn silage, and grass silage. In order to check amounts taken, at intervals the hay keeper and silo

were fenced off and weighed amounts of the roughages offered ad libitum for 24-hour periods. Table II summarizes average consumption per cow for these different roughage combinations.

On studying these data, it would appear that it might be possible to economize on the amount of concentrates fed, under some conditions, as combination 3, for example supplied about 17.9 pounds of total digestible nutrients while combination 1 furnished only 15.8 pounds.

The scale of such an economy will depend on the quality of the roughage. Moore (22) has represented the "values" found in good quality roughage as being a better source of vitamins and minerals, increased digestibility, and the greater consumption that can be obtained.

Dickson and Kopland (7) tried to determine to what extent a limited feed of grain with roughage and a ration consisting of roughage alone affected the quantity of milk from Holstein cows which were capable of good production. It was found that feeding grain at the rate of 1 pound for each 3 pounds of milk produced was wasteful. The authors stated that, under their conditions, 1 pound of grain fed for 6 pounds of milk produced proved adequate when fed with all the roughage the cows could consume. Cows fed thus produced 94 percent

TABLE II

AVERAGE DAILY CONSUMPTION PER COW OF ROUGHAGES IN DIFFERENT COMBINATIONS

Item	Hay (pounds)	Corn Silage (pounds)	Grass Silage (pounds)
Combination 1	15		41.7
Combination 2	7.6	33	19
Combination 3	13	57	
Combination 4		50	23

as much milk as did cows fed twice as much grain. It was also shown that feeding grain at 1 pound to 6 pounds of milk increased production by 22 percent over cows fed only roughage.

In 1946 Monroe and Livezey (21) reported on a two-level grain feeding trial carried out under farm conditions over a 3-year period. In this case, the moderate grain group which was fed at the rate of 1 pound for every 6.5 pounds of milk produced, resulted in 97 percent as much milk as did cows fed slightly more than twice as much grain. The curves of lactation for the two groups were approximately similar, thus indicating that the persistency of

the moderate grain group had not been adversely affected. This was in agreement with work done by Wylie and Neal (40).

Roughage Storage Losses

The losses in weight and dry matter during the storage of chopped alfalfa hay was studied by Woodward and Shepherd (39). On comparing the weights and the dry matter of the hay at the time of storage, with the weights at the time of feeding, it was found that there had been a loss of 21.5 percent in weight and 3.2 percent in dry matter during storage. Analysis showed the moisture had dropped from 25.31 percent to 7.93 percent, and that by far the greatest part of the dry matter loss was in the nitrogen-free extract. Data presented did not include losses between time of mowing and storage.

King (18), at the Wisconsin Agricultural Experiment Station in 1895, was one of the pioneers in determining losses during silage formation. It was reported that in one silo, 63.4 tons of corn was filled and 57.2 tons of good silage removed, representing a 10 percent loss in weight. The loss in dry matter was 8.1 percent. About the same time, similar losses were obtained at other stations, and Jordan (17) proved by feeding trials that silage formation caused a loss of nutritive value.

In 1924, the work of Ragsdale and Turner (27) demonstrated that there was an unavoidable loss of dry matter during the ensiling process averaging 7.5 percent for fifty-four silos when surface spoilage was taken into account.

Watson (35) considered losses involved in making silage in three categories: (1) drainage loss; (2) losses due to respiration and subsequent bacterial fermentation; and (3) loss due to waste resultant from such causes as molds. It was considered that (2) was unavoidable but where practices were sound, the losses under (1) and (3) were usually negliglble. Watson achieved greater accuracy in his determination by employing a correction to allow for the loss of volatile substances per 100 pounds of dry matter out of the silo. He considered that at no time more than one-quarter of the fresh crop nutrients should be lost in silage-making. As far as (1) is concerned, Archibald and Gunness (1) showed, from a 7-year study, that the seepage losses in silage were not serious; good management reduced it to an insignificant figure.

In 1941 a detailed silage investigation was reported from Beltsville (29) covering several seasons of making and feeding silage. For this work eight silos were used. All the corn was weighed as it was hauled to the ensilage cutter, and again as removed from the

silo 100 or more days later. Averaging the figures given for the six silos filled with well-eared corn silage showed that there was a 14.5 percent loss in dry matter. This included top spoilage, which varied from 8 to 18 inches in depth.

Silage Flavor in Milk

Ever since silage came into use as a feed for dairy cattle, its effect on the flavor and odor of the milk produced has been a controversial issue. Gamble and Kelly (10), as a result of their observations, stated that the flavor of silage is mainly imparted to the milk through the body of the cow. They found that when silage was fed 1 hour prior to milking, the flavor was very quickly absorbed, resulting in a pronounced milk taint. Leitch (19) reported that milk tainted by silage was caused by feeding silage just before milking or at any time when the silage was in a decomposed or moldy state.

Trout (33) recorded a particular case where a distinct "silage" flavor was found in milk which had been rejected repeatedly. This milk was traced to cows that had been fed silage just previous to milking. The herd owner reported that this flavor was eliminated when the feeding routine was changed.

The effect of feeding corn silage on milk flavor was studied by Roadhouse and Henderson (28), who offered 5 to 12 pounds of good quality corn silage to cows 1 to 2 hours before milking. It was found that there was a distinct feed flavor when 10 pounds of silage were fed 1 hour before milking, but none when 5 pounds were fed under similar circumstances. From these data, it can be concluded that silage feed flavor in milk definitely exists.

Feeding Behavior

Work has been done by Harshbarger (12) to determine the average rate at which dairy cows consume grain, silage, and hay. The rate of eating was highest for Holsteins and lowest for Jerseys, with other breeds intermediate. The average rates of feeding were found to range from 2 to 3 minutes per pound of grain, 1.75 to 2.75 minutes per pound of silage, and 7.16 minutes per pound of hay.

Johnson (16) studied individual cow activities under loose-housing conditions. Hay and silage eating time showed a range of 295 to 399 minutes with an average of 339 minutes per cow daily. Three-quarters of this total roughage eating time was spent eating silage. During the last three months of the winter in which the

observations were made, silage was not available; consequently the hay-eating time for this period was greater, ranging from 284 to 324 minutes, with an average of 304 minutes per cow per day. Eating was fairly well distributed throughout the day, but slight preference was shown to the the hours of 8 to 12 a.m.

Simultaneously with the above work, Porter, at Iowa (26), made some limited observations to find out how dairy cows would select roughage when offered a variety to choose from. The herd had direct access to hay and to above-ground stack silage. The average time daily per cow was 184 minutes eating silage and 39 minutes eating hay. During a 24-hour feeding period, it was found that each cow consumed, on an average, 57 pounds of corn silage and 13 pounds of hay.

EXPERIMENTAL MATERIALS AND METHODS

Materials

Barn and feed lot areas. The steel quonset-type loose-housing barn which is part of the Dairy Cattle Housing Research Project at Michigan State College, was used for this study. The unit includes two barns. One provides storage for cut straw at one end, lounge area in the center, and at the other end, calf and maternity pens, milking parlor, and milk room. The lounge area is open on the south side and faces on to a paved barn yard. The other barn is situated on the west of the paved yard and provides storage for chopped hay. As hay self-feeding was desired, a movable feeder was erected along the paved yard side of the hay barn through which the cows could feed. This fence was moved back into the barn as the hay was consumed. A self-feeding verticle silo was located at the south end of the paved yard area. Ample feeding space was provided at the self-feeders.

For the purpose of this work, it was necessary to divide the herd into two groups in order to place the cows on two different roughage rations. Figure 1 shows the buildings and silo lay-out and

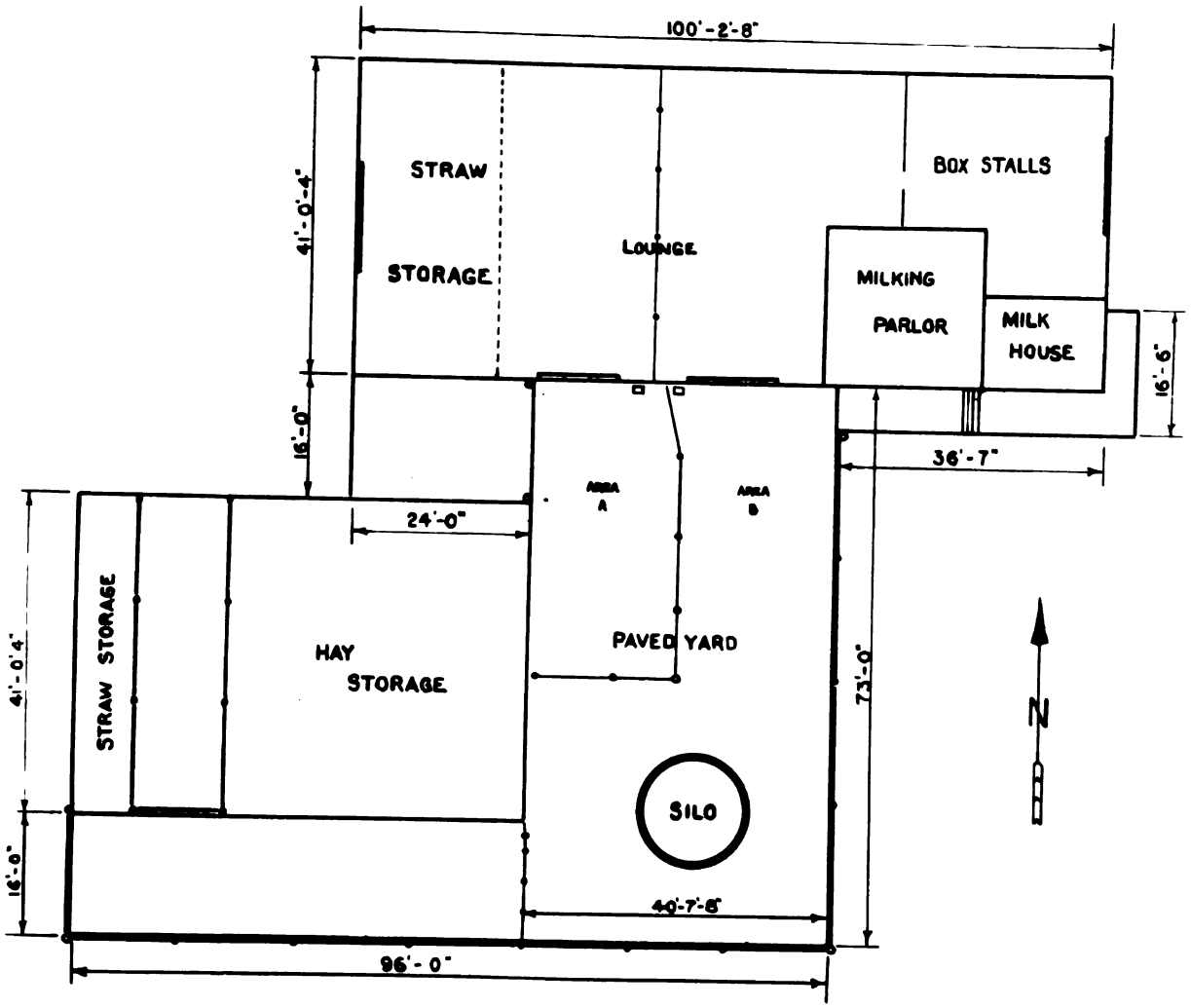

Figure 1. Scale diagram of the steel, quonset-type loose-housing barn and its feeding area on the Michigan State College dairy farm at East Lansing.

illustrates the division of the lounge and yard areas. Area A contained 1,336 square feet in area, being made up by 520 square feet inthe lounge and 816 square feet in the paved yard. This provided 58 and 91 square feet per cow, respectively. Area B was 3,556 square feet in area, being made up of 919 square feet in the lounge and 2,637 square feet in the paved yard, which represented 65 and 186 square feet per cow, respectively.

Cows used. Twelve Brown Swiss and eleven Holstein cows were used for this study. All the Brown Swiss, with the exception of Number 322, had spent the winter of 1952-53 in the loose-housing barn. The Holsteins, on October 7, 1953, occupied this type of housing for the first time. At the start of the study period in November, all the cows appeared to have normal udders and good appetites. Herd number, birth dates, date of last calving, and month of lactation of the experimental animals as of November 15, 1953. are shown in Table III.

Management practices. The herd was milked twice daily, at 5:00 a.m. and 5:00 p.m., receiving concentrates while in the milking parlor. It was possible to maintain the same concentrate mixture of 1,100 pounds of ground shelled corn, 400 pounds of oats, 200 pounds

TABLE III

DIVISION, BIRTH DATE, LAST CALVING DATES, AND STAGE OF LACTATION OF EXPERIMENTAL ANIMALS

Experimental Group	Herd No.	Breed	Date of Birth	Date of Last Calving	Month of Lactation	Calved During Experiment
I	322	Brown Swiss	1/22/41	11/19/52	11	
	350	"	8/23/45	9/11/53	2	
	365	"	8/7/47	4/3/53	7	
	367	"	10/13/47	7/20/53	4	
	369	"	3/13/48	1/12/53	dry	1/6/54
	490	Holstein	2/2/46	11/4/53	1	
	503	"	1/1/47	8/29/53	3	
	521	"	2/17/48	1/7/53	dry	2/2/54
	531	"	3/8/49	2/17/53	9	2/2/54
II	335	Brown Swiss	3/3/43	4/23/52	dry	11/21/53
	360	"	4/11/47	9/7/53	2	
	371	"	11/3/48	2/24/53	10	
	372	"	11/3/48	1/18/53	11	
	377	"	4/25/49	12/8/52	12	
	379	"	11/7/49	6/25/53	5	
	389	"	9/10/50	12/6/52	12	2/3/54
	466	Holstein	6/27/44	5/28/53	6	
	496	"	5/10/46	11/29/52	dry	12/24/53
	517	"	11/19/47	4/8/53	7	
	520	"	1/23/48	10/4/53	2	
	523	"	3/9/48	3/22/53	8	
	525	"	4/10/48	1/5/53	10	1/23/54
	533	"	5/21/49	1/31/53	10	1/31/54

of rye and 300 pounds of soybean oil meal throughout the experimental period. Except during milking, the cows were free to move at will between the lounge and yard in their respective areas.

The roughage used was medium quality alfalfa-brome hay and corn silage. It was recorded at filling time that 58.63 tons of chopped hay were put in the barn, and 118.5 tons of corn silage were put into the silo. The chemical analysis at the time of filling is given in Table IV.

Fresh hay was moved to the self-feeders after each milking, and the personnel of the Department of Agricultural Engineering controlled the fall of silage in the self-feeding silo so as to insure a constant supply.

The lounge area was bedded with chopped straw just before the evening milking, and the yard area was scraped weekly when weather permitted.

Methods

Each animal was weighed on November 15, 16, and 17, 1953, at the beginning of the trial. All the cows were weighed on three consecutive days; the average of these three weights was taken as the weight of the cow. This 3-day weighing was carried out approximately every 2 weeks throughout the test period.

TABLE IV

ANALYSIS OF ROUGHAGES AT STORAGE

Item	Percentage Composition	
	Hay	Silage
Water	31.89	67.37
N-Free Extract	28.60	19.37
Crude Fibre	27.16	8.53
Protein	7.00	2.44
Ash	4.05	1.60
Ether Extract	1.30	0.69

The herd was divided between areas A and B (Figure 1) on November 6, 1953, as shown in Table III. Prior to this date, all cows received concentrates at approximately 1 pound for each 2.7 pounds of milk produced and ad libitum hay and corn silage.

The two groups, although confined to their respective areas, were subjected to the same conditions with the exception of the feeding. Group I, in area A, had access to alfalfa-brome hay ad libitum. Group II, in area B, had access to ad libitum alfalfa-brome hay and corn silage. Although both roughages were self-fed, regular

watch was kept, especially during cold weather, to insure that a supply was readily available.

In order to obtain an indication of the amounts of silage eaten, on four periods throughout the trial, covering 10 days (24 hours), additional bunks were brought into the lot and the self-feeding silo was fenced off. All silage offered was weighed, and what was not consumed was weighed back after each 24 hours. The amount of hay consumed was similarly measured on five occasions covering a total of eleven days.

For the first 15 days of the experiment, November 15-30, 1953, all cows were fed concentrates at 1 pound for every 3.5 pounds of milk produced, but this rate was varied slightly depending on stage of lactation and general condition. The daily milk weight was recorded in the course of usual routine.

Starting on December 2, 1953, the concentrate feeding rates indicated in Table V were adopted. Table VI shows how Group I was subdivided into lots A and B and the concentrate rate of feeding for the seven 15-day periods ending December 16, December 31, January 15, January 30, February 14, March 1, and March 16, 1954. Table VII shows similar information in relation to Group II, but in this group, three lots, A, B, and C, were used.

TABLE V

CONCENTRATE FEEDING RATES

Daily Milk Yield (lbs.)	Rate (pounds of concentrate fed daily)[1]			
	1	2	3	4
0	0	0	0	2
5	0	0	0	4
10	0	0	2	6
15	0	0	4	8
20	0	2	6	10
25	0	4	8	12
30	2	6	10	14
35	4	8	12	16
40	6	10	14	18
45	8	12	16	20
50	10	14	18	22
55	12	16	20	24
60	14	18	22	26
65	16	20	24	28
70	18	22	26	30

[1] At high levels no more concentrates were fed than the cow clean up readily.

TABLE VI

GROUP I. CONCENTRATE FEEDING RATES FOR FIFTEEN-DAY PERIODS BETWEEN DECEMBER 2, 1953, AND MARCH 16, 1954

Lot	Herd No.	Feeding Period: Dec. 2-16 (rate)[1]	Dec. 17-31 (rate)	Jan. 1-15 (rate)	Jan. 16-30 (rate)	Jan. 31-Feb. 14 (rate)	Feb. 15-Mar. 1 (rate)	Mar. 2-16 (rate)
A	350	3	4	3	4	4	3	3+ silage
	367	3	4	3	4	4	-[b]	-
	490	4[a]	4	3	4	4	3	3
	322	dry[2]	dry	dry	dry	dry	dry	dry
	531	dry	dry	dry	dry	dry	4[a]	4
B	503	4	3	4	3	3+ silage	3	3
	365	4	3	4	3	3+ silage	dry	dry
	369	dry	dry	4[a]	4	4	3	3
	521	dry	dry	dry	dry	4[a]	4	4

[1] Using Table V, read off pounds of concentrates per day against milk yield.

[2] Dry cows received 4 pounds of concentrate per day.

[a] High rate till past lactation peak.

[b] Cow withdrawn from herd.

TABLE VII

GROUP II. CONCENTRATE FEEDING RATES FOR FIFTEEN-DAY PERIODS BETWEEN DECEMBER 2, 1953, AND MARCH 16, 1954

Lot	Herd No.	Feeding Period: Dec. 2-16 (rate)[1]	Dec. 17-31 (rate)	Jan. 1-15 (rate)	Jan. 16-30 (rate)	Jan. 31-Feb. 14 (rate)	Feb. 15-Mar. 1 (rate)	Mar. 2-16 (rate)
A	525	dry[2]	dry	dry	dry	3[a]	3	3
	335	3[a]	3	3	1	1	3	3
	372	1	2	3	1	1	3+ hay	3
	517	1	2	3	1	1	3	3+hay
	533	1	dry	dry	dry	3	3	3
B	520	2	-[b]	-	-	-	-	-
	496	dry	dry	3[a]	3	2	2	3
	466	2	3	-[b]	-	-	-	-
	379	2	3	1	3	3	3	3
	377	2	3	1	3	3	3	3
C	523	3	1	2	dry	dry	dry	dry
	371	3	1	2	3	3	3	3
	360	3	1	2	3	3	3	3+hay
	389	3	1	dry	dry	dry	-[b]	-

[1] Using Table V, read off pounds of concentrate per day against milk yield.

[2] Dry cows received no concentrates.

[a] High rate till past lactation peak.

[b] Cows withdrawn from herd.

Unfortunately, cows 466 and 520 had to be removed from the herd and the experiment during December, 1953, 367 and 389 in February, 1954, and 523 died as a result of milk fever in March. Number 466 continually came in heat with resultant abnormal production, and the other three cows developed acute mastitis. Cows 369, 490, 496, and 503 also developed mastitis during the experimental period, and consequently their production records could not be used.

Individual milk samples were taken at the evening milking on December 21, 1953, February 9 and 23, 1954, and at the morning milking on December 22, 1953, February 10 and 24, 1954. A composite milk sample was also drawn from the bulk tank at the steel barn on December 22, 1953. All these samples were examined and judged for milk flavor using the score guide shown in Appendix Table XVIII. During December, January, and February, the milk was examined bacteriologically at intervals.

As careful a record as possible was kept of any silage which was removed from the self-feeding silo from time to time, either for other stock or because unfit for stock due to spoilage.

An analysis was made of three hay and silage samples taken January, February, and March, 1954, respectively.

Cow activity studies were carried out as a 24-hour observation for a total of three days during the experimental period. Every 10 minutes during the studies the number of cows (1) eating silage, (2) eating hay, (3) loitering in the yard, (4) loitering in the lounge or being milked, and (5) resting in the lounge were recorded. In order to avoid all possible disturbance of the cows during the hours of darkness, a hand flashlight was used to check the cows instead of using the barn lights. These activity studies were carried out on the following dates:

1. December 22, 12:00 to 8:00 a.m.; December 26, 8:00 to 2:00 p.m.; December 22, 2:00 to 12:00 p.m.
2. January 2, 12:00 to 12:00 a.m.; January 3, 12:00 to 12:00 p.m.
3. February 5, 6:00 p.m. to February 6, 6:00 p.m.

By way of a summary of methods, the records kept during this investigation were:

1. Cow body weights.
2. Daily consumption of roughages on specified days.
3. Milk production.
4. Milk flavor and bacteria count.
5. Silage waste or silage removed.
6. Cow activities during 24 hours.

RESULTS AND DISCUSSION

While the five management studies carried out, namely roughage consumption, behavior of cows, silage feeding losses, milk flavor and roughage effect on concentrate requirement, are all intimately associated, the results are presented and discussed under these respective headings.

Roughage Consumption

Determinations were made of the amount of hay consumed daily by animals in group I receiving hay as their only roughage and also the amount of hay and silage consumed daily by animals in group II.

The hay consumption for group I animals is shown in Table VIII based on data obtained from four feeding periods made up of a 3- and a 2-day period in November, a 2-day period in December, and a 3-day period in January, making a total of 10 days. During the first feeding period in November the hay was weighed and moved to the self-feeders every 24 hours. Observations suggested that the amount of hay consumed under these conditions was not reflecting a

TABLE VIII

HAY CONSUMPTION OF GROUP I DURING FOUR FEEDING PERIODS IN NOVEMBER, DECEMBER, AND JANUARY

Feeding Date	No. of Days	No. of Cow Days	Pounds of Hay Eaten	
			Total	Avg. per Cow Daily
Nov. 16-19, 1953	3	27	455	16.9[a]
Nov. 22-24, 1953	2	16	317	19.8
Dec. 26-28, 1953	2	18	409	22.7
Jan. 28-31, 1954	3	25	575	23.0
Total	7	86	1,756	22.0

[a] Omitted when computing over-all average.

true day-by-day picture. Accordingly, for the second and subsequent feeding periods, the hay was weighed and moved to the self-feeders every 12 hours, resulting in a 17.2 percent increase in consumption which was more than maintained in the remaining two feeding periods. The amount consumed was found to vary between the feeding periods from 16.9 pounds per cow daily in November to 23 pounds per cow daily in January. In computing the over-all average of 22 pounds per

cow daily, it was felt that the reason given above justified omitting the 16.9 pounds consumption obtained in the first feeding period.

Table IX shows the silage and hay consumption of group II experimental animals when these roughages were hand fed. The silage was offered to the cows ad libitum in bunks which were brought into the lot especially for the purpose on 5 days in November, 2 days in December, and 3 days in January, making a total of 10 days. The average consumption of silage per cow daily ranged, between the feeding periods, from 53.3 pounds to 60.2 pounds. The low consumption was again obtained in the first feeding period when more than a 3-day supply was offered at once. During the first day of the period the cows demonstrated normal feeding habits, but by the third day, the silage had started to heat badly with the top surface well "picked-over" resulting in an obvious lack of interest in the silage on the part of the cows. As a result of this experience, in subsequent silage feeding periods, a quantity of fresh silage was weighed out every 12 hours, thus coming more in line with the feeding conditions which existed when cows fed directly from the self-feeding silo. The result obtained in the first silage feeding period was not taken into account when calculating the over-all silage consumption of 58.6 pounds per cow daily. The hay consumption of

TABLE IX

SILAGE AND HAY CONSUMPTION OF GROUP II DURING SIX FEEDING PERIODS IN NOVEMBER, DECEMBER, JANUARY, AND FEBRUARY

Feeding Date	No. of Days	No. of Cow Days	Pounds of Silage Eaten		Pounds of Hay Eaten	
			Total	Avg. per Cow Daily	Total	Avg. per Cow Daily
Nov. 16-19, 1953	3	42	2,238	53.3[a]	293	7.0
Nov. 22-24, 1953	2	28	1,630	58.2	174	6.2
Dec. 26-28, 1953	2	22	1,250	56.8	169	7.7
Jan. 22-25, 1954	3	32	1,926	60.2	---	---
Jan. 28-31, 1954	2	24	-----	----	173	7.2
Feb. 25-27, 1954	2	21	-----	----	153	7.3
Total Silage	7	82	4,806	58.6	---	---
Total Hay	11	137	-----	----	962	7.0

[a] Omitted when computing silage over-all average.

group II animals was obtained for 11 days, embracing 5 feeding periods during November, December, January, and February. The consumption did not vary much between the feeding periods and the average amount of hay consumed by these animals was found to average 7.0 pounds per cow daily.

No rain or snow was experienced during any of the feeding periods reported, and therefore, the weighing back of the roughages at the termination of the feeding periods was possible without requiring consideration of changes in moisture content. Two other points observed throughout the entire experimental period are related to the silage-fed group II animals. They obviously tended to be far more "choosey" as to the quality of hay which they would eat; this was especially apparent when the self-feeders were being cleared as the hay removed from group II feeders was always superior to that removed from group I feeders. The feces from group II animals were consistently slightly softer than those from group I.

The hay and silage was sampled and analyzed on January 1, February 1, and March 1, 1954. Table X shows the analyses of the hay used by group I and hay and silage used by group II. In the same table the average analysis is shown and also the total digestible

TABLE X

ANALYSIS AND TOTAL DIGESTIBLE NUTRIENT CONTENT OF ROUGHAGES

	Silage				
	Jan.	Feb.	Mar.	Avg.	T.D.N.
Water	69.44	67.83	65.83	67.70	-----
N.F.E.	18.02	19.45	20.49	19.32	13.33
Fibre	7.51	7.27	8.31	7.69	5.13
Protein	2.59	2.69	2.85	2.71	1.43
Ash	1.55	1.69	1.62	1.62	-----
Ether extract	0.89	1.07	0.90	0.93	1.55
	Hay Group I				
Water	9.37	9.10	9.33	9.27	-----
N.F.E.	39.18	38.84	38.53	38.85	27.19
Fibre	35.63	33.11	35.98	34.91	15.36
Protein	9.25	11.13	9.44	9.94	7.06
Ash	4.98	5.97	5.22	5.39	-----
Ether extract	1.59	1.85	1.50	1.65	1.19
	Hay Group II				
Water	10.31	9.69	9.46	9.82	-----
N.F.E.	40.28	37.82	39.24	39.11	27.38
Fibre	34.74	37.00	37.19	36.31	15.98
Protein	8.19	9.06	8.31	8.52	6.05
Ash	4.66	4.99	4.35	4.66	-----
Ether extract	1.82	1.44	1.45	1.57	1.13

nutrient values calculated by using the digestion coefficients given by Morrison (23).

On January 19, 1954, a composite hay sample was drawn from both sections of the hay barn and graded according to U.S. standards. It was found to be of Number 2 U.S. grade in color and leaf. The sample was made up of Timothy (bud and early bloom) 75 percent, Alfalfa (bloom) 15 percent, Brome (early bloom)5 percent, and a trace of Kentucky blue grass, Quack, and foreign matter.

Table XI shows the total digestible nutrients supplied by the roughages to the two groups. Using Morrison's feeding standards for a 1,400-pound dairy cow of 10.0 pounds of T.D.N. for maintenance and 0.32 pounds of T.D.N. per pound of milk, it can be calculated that group I cows should have produced 3.65 pounds of milk as well as provided for body maintenance from hay alone. Similarly, group II cows should have produced 19.03 pounds of milk, as well as provided for body maintenance from their roughage.

Behavior of Cows

By way of a follow-up on the cow activity studies carried out by Johnson (16) and Lewis and Johnson (20), cow activities were recorded during three 24-hour observation periods in late December,

TABLE XI

POUNDS OF TOTAL DIGESTIBLE MATERIALS PER COW DAILY SUPPLIED BY ROUGHAGES

Group	Roughage	Percent T.D.N.	Avg. Pounds per Cow Daily	Pounds T.D.N. Daily
I	Hay	50.90	22.0	11.17
II	Hay	50.41	7.0	3.53
	Silage	20.84	58.6	12.56

early January and early February. As in the previous study, the cows were free to come and go at will between the lounge and the paved yard. However, as the cows were in two groups, as already described, it was possible to study the habits of the cows feeding on hay alone simultaneously with the cows in the group feeding on silage and hay.

Data on cow activities at 10-minute intervals during the three 24-hour periods are shown in Tables XIX, XX, and XXI in the Appendix. The main interest this year was in the hay and silage eating time; nevertheless loitering and resting observations were again made. Table XII shows the average time spent by group I

TABLE XII

AVERAGE TIME SPENT BY GROUP I ANIMALS EATING, LOITERING, AND RESTING FOR THREE TWENTY-FOUR HOUR OBSERVATION PERIODS

Activity	Observation Dates							
	Dec. 22, 26		Jan. 2, 3		Feb. 5, 6		Average	
	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.
Eating hay	326	22.6	342	23.7	320	22.2	329	22.9
Loitering in yard	162	11.2	151	10.5	100	7.0	138	9.5
Loitering in lounge	344	24.0	346	24.0	465	32.3	385	26.7
Resting in lounge	608	42.2	601	41.8	555	38.5	588	40.9

animals eating, loitering, and resting for the three 24-hour observation periods expressed in minutes and percentages. Table XIII records similar information for group II animals. The percentage of each hour devoted by the animals to the various activities is illustrated diagrammatically in Figures 2 and 3; these percentages being the average of the three 24-hour periods.

The weather data for days of cow activity studies were obtained from the U.S. Weather Bureau of East Lansing. Table XIV

TABLE XIII

AVERAGE TIME SPENT BY GROUP II ANIMALS EATING, LOITERING, AND, RESTING FOR THREE TWENTY-FOUR HOUR OBSERVATION PERIODS

Activity	Observation Dates							
	Dec. 22, 26		Jan. 2, 3		Feb. 5, 6		Average	
	Min.	Pct.	Min.	Pct.	Min.	Pct.	Min.	Pct.
Eating silage	246	17.0	273	19.0	166	11.5	228	15.8
Eating hay	87	6.0	63	4.4	53	3.7	68	4.8
Loitering in yard	152	10.6	276	19.1	215	14.8	214	14.8
Loitering in lounge	278	19.3	195	13.5	462	32.2	312	21.7
Resting in lounge	677	47.1	633	44.0	544	37.8	618	42.9

shows for each day the maximum, minimum, and average temperature, precipitation, and speed and direction of wind. It was considered that the weather did not influence the eating habits on the days the observations were made.

Eating hay. Group I animals, all of which were on hay alone, spent an average of 329 minutes, or 22.9 percent, of each 24-hour

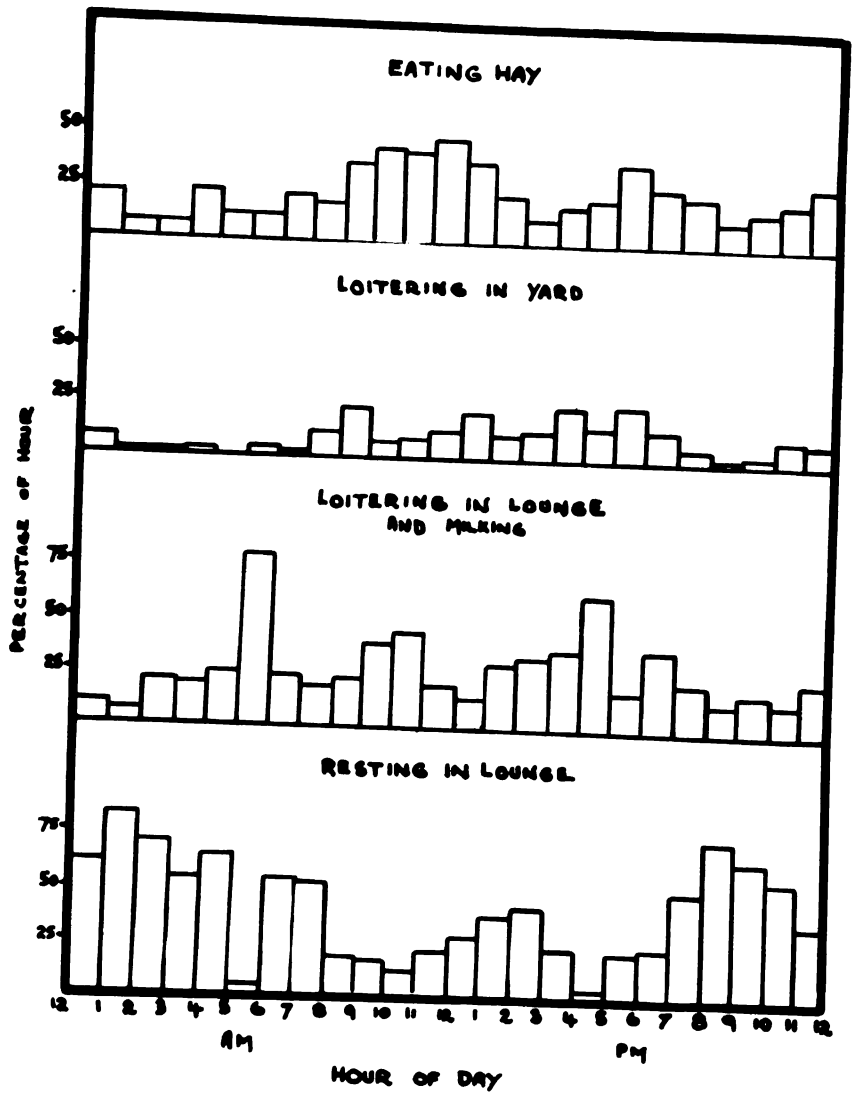

Figure 2. Hourly distribution of time at various activities by animals in group I.

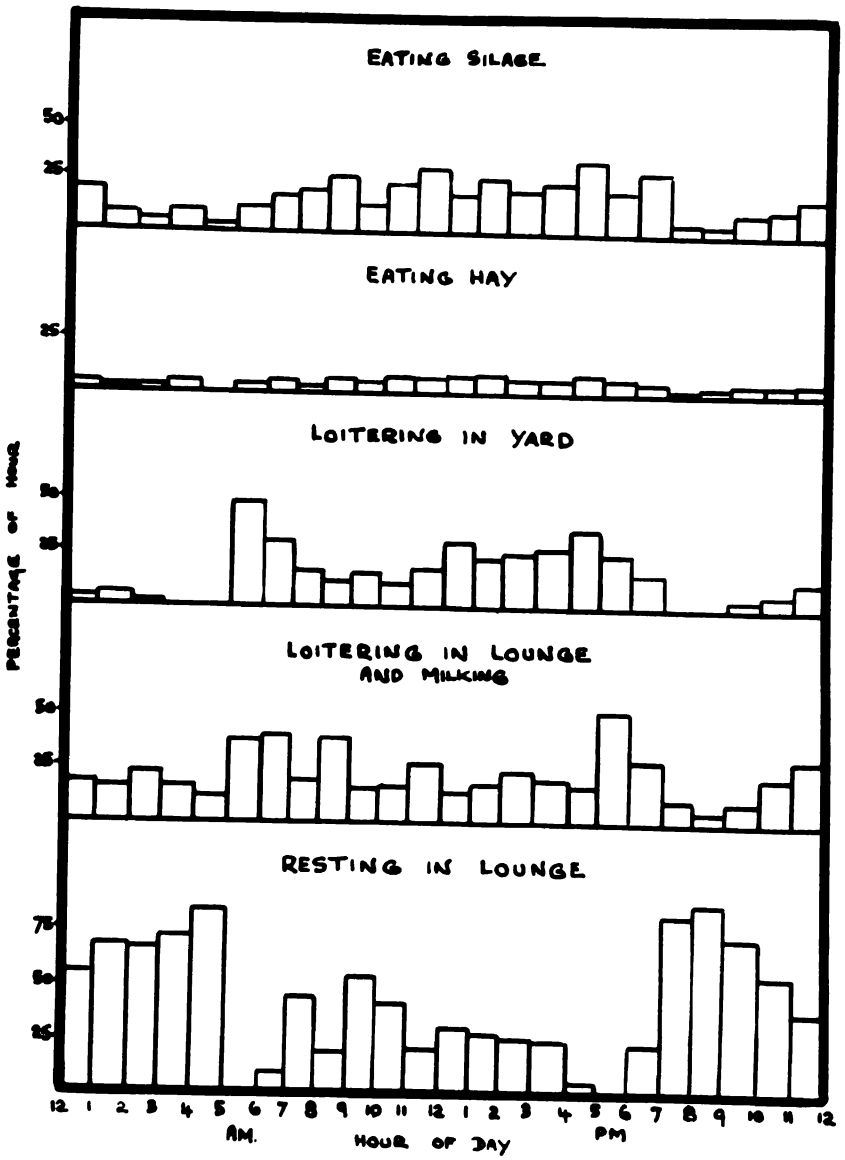

Figure 3. Hourly distribution of time at various activities by animals in group II.

TABLE XIV

WEATHER DATA FOR DAYS OF COW ACTIVITY STUDIES

Weather Data	Observation Dates				
	Dec. 22	Dec. 26	Jan. 2	Jan. 3	Feb. 5
Temperature (°F.)					
Maximum	39	36	46	36	34
Minimum	19	27	32	22	22
Average	29	32	39	29	28
Precipitation (in.)					
Total	0.24	0.08	0	trace	0.01
Snow on ground (in.)	3.7	0.8	0	0	trace
Wind (mph)					
Average speed	16.0	17.4	15.9	13.8	13.8
Fastest speed	25	29	22	26	27
Direction	NNW	WNW	SSW	NW	WNW

period eating hay. Table XII shows no great variation between the three periods. As it has been shown that each cow in this group consumed an average 22 pounds of hay daily, it was calculated that under these conditions a cow required 14.9 minutes to eat one pound

of hay. This is rather slower than the rate indicated by Harshbarger (12) in his work with similar cows. Group II animals each spent an average of 68 minutes or 4.8 percent of each 24-hour period eating hay. As this group consumed an average of 7 pounds per cow daily, this represents a slightly faster rate of eating hay, consuming 1 pound in 9.7 minutes.

Figures 2 and 3 show that hay eating occurred during all hours of the day and night. In group II, the animals' eating time was fairly evenly distributed with a slight preference for hours of daylight. On the other hand, group I animals showed a definite eating peak from 7:00 a.m. to 2:00 p.m., and again from 4:00 to 8:00 p.m. These peaks coincided with the hours immediately following fresh hay being moved to the self-feeders at 7:00 a.m. and 4:00 p.m.

Eating silage. An average of 228 minutes or 15.8 percent of each 24-hour period was devoted to eating silage by the group II animals. More than three-quarters of the roughage eating time of this group was spent eating silage. It was also found that, generally, the sum of the hay and silage eating time of group II did not exceed the hay eating time of group I animals. Silage eating was done during the night, but, as shown in Figure 3, a definite preference was shown for the hours between 7:00 a.m. and 7:00 p.m. and to a

lesser extent between 10:00 p.m. and 1:00 a.m. As these cows were consuming approximately 58 pounds of silage per day, it would indicate that they were eating one pound of silage in 3.9 minutes. This rate which is slower than that found by Harshbarger, probably is characteristic of self-feeding. It was because of the high silage consumption and the observation that silage eating occurred, under these self-feeding conditions, in the hours immediately before milking that the decision was made to include a milk flavor study.

Loitering in yard. The time spent loitering in the paved yard was quite different between the two groups. Group I animals loitered for an average of 138 minutes of 9.5 percent of each 24-hour period, whereas group II animals spent an average of 214 minutes of 14.8 percent in loitering. Two factors are considered to give reasonable explanation for this dissimilarity. Firstly, as has been reported already, group I animals tended to spend a longer time eating, and this would appear to have an inverse relationship with yard loitering time. Secondly, the necessary management practice of confining group II animals to the paved yard while the other group was being milked was inclined to inflate yard loitering time. The difference in the paved yard area per animal was regarded to have no influence on the loitering time. Most of the yard loitering was done during the

day, as would be expected; group I being at its highest level from 7:00 a.m. to 7:00 p.m., and group II from 5:00 a.m. to 7:00 p.m. No animal was observed to rest in the yard during the three study periods or at any other time during the experimental period until March 18.

Loitering in lounge. Group I animals spent 385 minutes, or 26.7 percent, of each 24-hour period loitering in the lounge, whereas group II spent 312 minutes, or 21.7 percent, at that activity. Time spent loitering in the lounge was fairly evenly distributed throughout the day and night, with the exception of 5:00 to 6:00 a.m. and 4:00 to 5:00 p.m. in group I. These two peaks can be explained by the routine at milking. For this study the time spent by the animals in the milking parlor was included with loitering in the lounge, and consequently expressed in the one set of figures.

Resting in lounge. The average time spent by the two groups resting in the lounge were very similar. Group I averaged 588 minutes, or 40.9 percent, of the 24-hour period, and group II averaged 618 minutes, or 42.9 percent. However, the latter group of animals showed a greater variation between the three 24-hour periods ranging from a high of 677 minutes on December 22 to a low of 544 minutes

on February 5 and 6. The chronological day-by-day record shows that on February 6 one animal in group II came in "heat" and was put in the maternity pen at 9:00 a.m. This fact would appear to adequately explain why the resting time was low and time loitering in lounge high on this occasion as the presence of the cow in "heat" during the hours immediately prior to its confinement would be unsettling to the other animals.

Milk Flavor

Individual milk samples were taken at the evening milking on December 21, 1953, February 9 and 23, 1954, and at the morning milking on December 22, 1953, February 10 and 24, 1954. The evening samples were held in cold storage overnight and examined with the next morning's samples. The milk scoring guide shown in Table XVIII of the Appendix was used, and the sample numbers were coded in order that the examiner could remain completely unbiased.

Table XV shows the results obtained on examining the three sets of evening and morning milk samples. The report on the December evening and morning samples suggests an obvious difference between the two groups, as 70 percent of the evening and morning milk samples taken from the cows on silage and hay were found

TABLE XV

FLAVOR SCORES AND DEFECTS OF INDIVIDUAL MILK SAMPLES

Group	Herd No.[1]	Dates of Sampling					
		Dec. 21-22		Feb. 9-10		Feb. 23-24	
		Evening	Morning	Evening	Morning	Evening	Morning
I (hay)	350	40	39 salt	32 salt	34 salt	35 feed	40
	365	40	40	-	-	-	-
	367	40	40	-	-	38 feed	40
	369	-	-	36 feed	34 flat	38 feed	40
	372	-	-	-	-	40	38 salt
	490	40	40	37 feed	34 salt	39 feed	38 salt
	503	40	40	-	-	35 feed	40
	521	-	-	36 feed	33 salt	40	40
	531	-	-	35 feed	35	35 feed	35 feed
II (silage & hay)	335	36 feed	40	37 feed	34 rancid	36 feed	40
	360	37 feed	40	38 feed	40	38 feed	40
	365	-	-	36 feed	38 salt	-	-
	371	37 feed	37 feed	32 rancid	39 flat	40	39 flat
	372	36 feed	38 salt	34 feed	37 salt	-	-
	377	35 feed	40	35 salt	39 salt	38 feed	38 salt
	379	35 feed	40	37 feed	39 feed	40	40
	389	36 feed	35 feed	-	-	-	-
	466	40	38 feed	-	-	-	-
	496	-	-	37 feed	38 salt	35 feed	37 feed
	503	-	-	35 feed	40 rancid	-	-
	517	35 feed	35 feed	34 feed	37 salt	36 feed	38 salt
	523	35 feed	35 feed	-	-	-	-
	525	-	-	37 feed	40	35 feed	40
	533	-	-	40	37 feed	35 feed	40

[1] Nos. 365, 372, and 503 were in both roughage groups.

to have a feed flavor whereas the milk from the group on hay only, without exception, was found to be free of feed flavor. However, no conclusion can be made as this finding was not repeated in either of the other samples in February; their examination showed 41 and 39 percent feed flavor in the silage-hay group, as against 40 and 38 percent feed flavor in the group on hay alone. The silage being fed during December was fresher and appeared to have a stronger "silage" aroma than that fed during February. At no time on or near the milk sampling periods was moldy silage accessible to the cows.

The milk consistently exhibited a higher incidence of feed flavor in the evening milking sample. An average of all samples showed 79 percent of the feed flavors occurred in the evening samples and only 21 percent in morning samples. This finding is related to the activity study in that more roughages were consumed before the evening milking than before the morning milking.

Standard bacterial plate counts were carried out on composite milk samples from the steel barn bulk milk tank during December, January, February, and March, the results of which are shown in Table XVI. While these counts were not as low as normally desirable, they were far short of counts liable to influence milk flavor.

TABLE XVI

STANDARD PLATE COUNTS OF MILK SAMPLES COLLECTED AT THE STEEL PEN BARN

Date	Bacteria/ml.
12/18/53	66,000
12/23/53	12,000
12/28/53	45,000
12/30/53	3,000
1/4/54	51,000
1/6/54	18,000
1/8/54	38,000
1/11/54	63,000
1/18/54	40,000
1/20/54	66,000
2/1/54	27,000
2/3/54	16,000
2/5/54	31,000
2/26/54	26,000
3/10/54	84,000

Silage Feeding Losses

The silo was filled with 118.5 tons of corn silage on September 16, 17, and 18, 1953. From work done by the U.S.D.A. Dairy Husbandry Research Branch at Beltsville (29), it can be assumed that a loss of approximately 10 percent of the dry matter results from respiration, fermentation, and seepage which occurs during storage in the normal types of silo. There is some question as to whether this percentage loss is applicable for the self-feeding silo used in this trial as in this type there is so much surface exposure.

Table XXII in the Appendix gives a record of the cow days eating silage and hay. Taking the silage consumption during the experimental period as 58.6 pounds per cow daily, 56.43 tons were eaten by March 16. From the seventeenth of March until the silo was emptied on April 1, the quality of the silage was inferior, having a high percentage of mold. Because of this the silage consumption during this final period was found, by an extra 2-day feeding trial on March 25 and 26, to be reduced to 39.7 pounds per cow daily, thus accounting for an additional 2.98 tons. The summation of these two periods allows it to be assumed that 59.41 tons of silage were consumed by the cows from October 23 when the silo was opened until it was empty on April 1.

One load of spoiled silage had to be removed when the silo was opened in October, and four loads when the edible silage was finished on April 1. At intervals throughout the winter, loads of spoiled silage had to be removed. This was usually the result of excess silage coming down off the "roof" resulting in heating and molding before the silage could be eaten. Spoiled silage thus removed could generally be considered only as manure, although the heifers were allowed to "pick-over" the best of it. Appendix Table XXIII shows the date and weight of each load of spoiled silage removed, totaling 30.02 tons. The same table also records an additional 2.68 tons of edible silage removed from the silo for other stock.

From these records, 92.11 tons of 118.5 tons of the silage filled can be accounted for. The balance of 26.39 tons was lost due to respiration, fermentation, and seepage, and also to the spillage of silage on to the paved yard, especially at times when too much silage was before the cows. Feces contamination prevented the weighing of this spilled silage. In trying to explain this 26.39 ton balance, consideration was given also to the possibility that, despite the numerous feeding trials, the average silage consumption used in the calculations may be low by virtue of the fact that the cows were taking more

when feeding direct from the self-feeding silo. However, this does not seem to have much foundation as even after a restricted silage supply on January 21, the cows averaged only 60 pounds daily for the next 3 days.

Summarizing, of the 118.5 tons of corn silage placed into the silo, 62.09 tons, or 52.4 percent, was fed, 30.02 tons, or 25.3 percent was weighed as spoiled, and 26.39 tons, or 22.3 percent--the balance--unaccounted for. As there was a slight difference between percent dry matter at filling and feeding, those percentages when put on a dry matter basis read as 50.5, 24.4, and 25.1 percent respectively. No matter how these figures are studied, they represent excessive storage and/or feeding losses, indicating an urgent need for further modifications in this self-feeding silo before it can be considered seriously for general farm use.

Concentrate Feeding in Relation to Roughages

The results in this section are most inconclusive. This was, in the main, due to the fact that out of the twenty-three milk cows, because of stage of lactation and health, only ten cows were considered suitable for study during the first five of the 15-day concentrate feeding periods which started on December 2, December 17,

January 1, January 16, and January 31, respectively. Four of these cows, 350, 367, 503, and 365, were in group I on hay alone; the remaining six, 372, 517, 377 379, 360, and 371, were in group II on silage and hay. For the last two 15-day concentrate feeding periods starting February 15 and March 2, owing to two further cases of mastitis and one cow going dry, the experimental animals in the concentrate study were reduced to seven; two on hay alone, and five on silage and hay.

These cows received their daily concentrate ration in the milking parlor at each milking by way of an automatic feeder. While every care possible was taken to measure out the concentrates accurately to prescribed levels, it was found that with three of the four feeders, the cows were able to "tongue" out extra feed. Close watch was carried out to prevent this practice, nevertheless no guarantee can be given that certain cows did not receive extra concentrates on occasion. Because of this factor, and also the one of few numbers of experimental animals, no attempt has been made to draw any general conclusions from the work involved in this section. Where thought permissable, one or two indications have been made which may prove helpful pointers should this study be continued.

Table XVII shows the grouping of the experimental animals used and the concentrate rate of feeding given during each of the seven 15-day periods. For simplicity, the first five of these periods are discussed as one phase and the remaining two periods as another phase. Tables XXIV and XXV in the Appendix tabulate individual milk production records based on 3- and 15-day averages, respectively.

In group I, cow numbers 350 and 367 were put on concentrate rate 3 starting December 2, and cow numbers 365 and 503 were, at the same time, put on rate 4. At the end of the first 15 days the rates were reversed and this change-over was repeated after the second and third 15-day periods. Figure 4 shows that the milk production was consistently stimulated when the respective cows went back on to rate 4. Cows transferred from rate 4 to rate 3 showed an 8.8 percent drop in production, whereas cows transferred from rate 3 to rate 4 only showed a drop in production of 3.4 percent. Correlating this with the work done by Turner (34), it would seem to indicate that a concentrate rate in the neighborhood of 4, under these conditions, would be necessary to maintain a normal production curve. At the end of the fourth period the concentrates given to cow numbers 365 and 503 were not changed from rate 3,

TABLE XVII

EXPERIMENTAL ANIMALS, CONCENTRATE FEEDING RATE,[1] AND PERIOD

Group	Lot	Herd No.	Feeding Periods			
			First Phase			
			Dec. 2-16 (rate)	Dec. 17-31 (rate)	Jan. 1-15 (rate)	Jan. 16-30 (rate)
I	A	350	3	4	3	4
		367	3	4	3	4
	B	365	4	3	4	3
		503	4	3	4	3
II	A	372	1	2	3	1
		517	1	2	3	1
	B	377	2	3	1	3
		379	2	3	1	3
	C	360	3	1	2	3
		371	3	1	2	3

[1] Using Table V, read off pounds of concentrate per day against milk yield.

TABLE XVII--Continued

Feeding Periods					
	Second Phase				
Jan. 31-Feb. 14 (rate)	Group	Lot	Herd No.	Feb. 15-Mar. 1 (rate)	Mar. 2-16 (rate)
3	I	-	350	3+hay	3+silage
3			372	3+hay	3+silage
3+silage					
3+silage					
1	II	A	360	3+silage	3+hay
1			517	3+silage	3+hay
3		B	335	3+silage	3+silage
3			371	3+silage	3+silage
3			379	3+silage	3+silage
3					

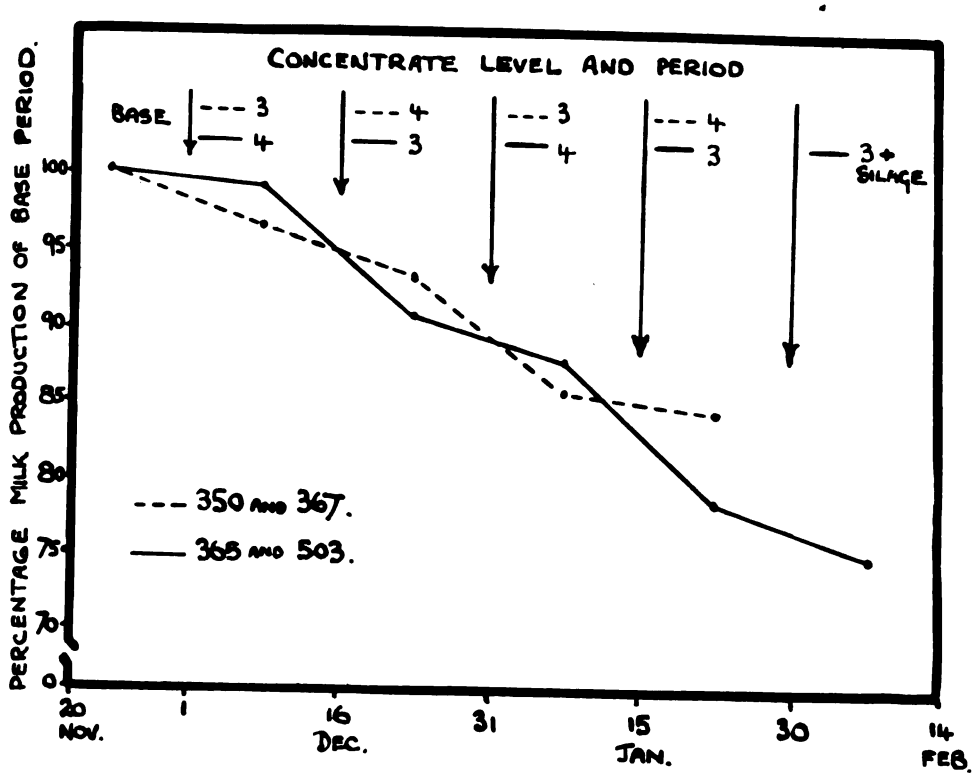

Figure 4. Effect on milk production of alternating group I animals between concentrate rates 3 and 4. Periods were of 15-day duration.

but the cows were given ad libitum access to the corn silage. Figure 4 shows, as a result, a leveling off of production almost identical to that experienced by these cows previously when changed from rate 3 to 4. This suggests that the ration of silage plus hay and concentrates at rate 3 was at least equal to a ration of hay and concentrates at rate 4.

In group II, three pairs of cows, 372 and 517, 377 and 379, and 360 and 371, were alternated between concentrate rates 1, 2, and 3 for three periods commencing December 2. For the fourth and fifth periods, commencing January 16 and January 31, respectively, 372 and 517 were kept on rate 1 and the other four cows were given rate 3. When cows were changed on to rate 3, there was in most cases a definite leveling off of the production graph, as shown in Figure 5. Cows going from rate 1 to rate 3 did not drop in production; cows going from rate 2 to rate 3 showed an average drop in production of 3.3 percent, and those going from rate 3 to rate 1 showed a drop of 12.1 percent. The same graph shows that cows 372 and 517 which were on rate 1 for both the fourth and fifth period tended to check their decline in milk production during the fifth period. It leaves an open question as to an explanation. Did the cows learn to adapt themselves to the low rate of concentrates by

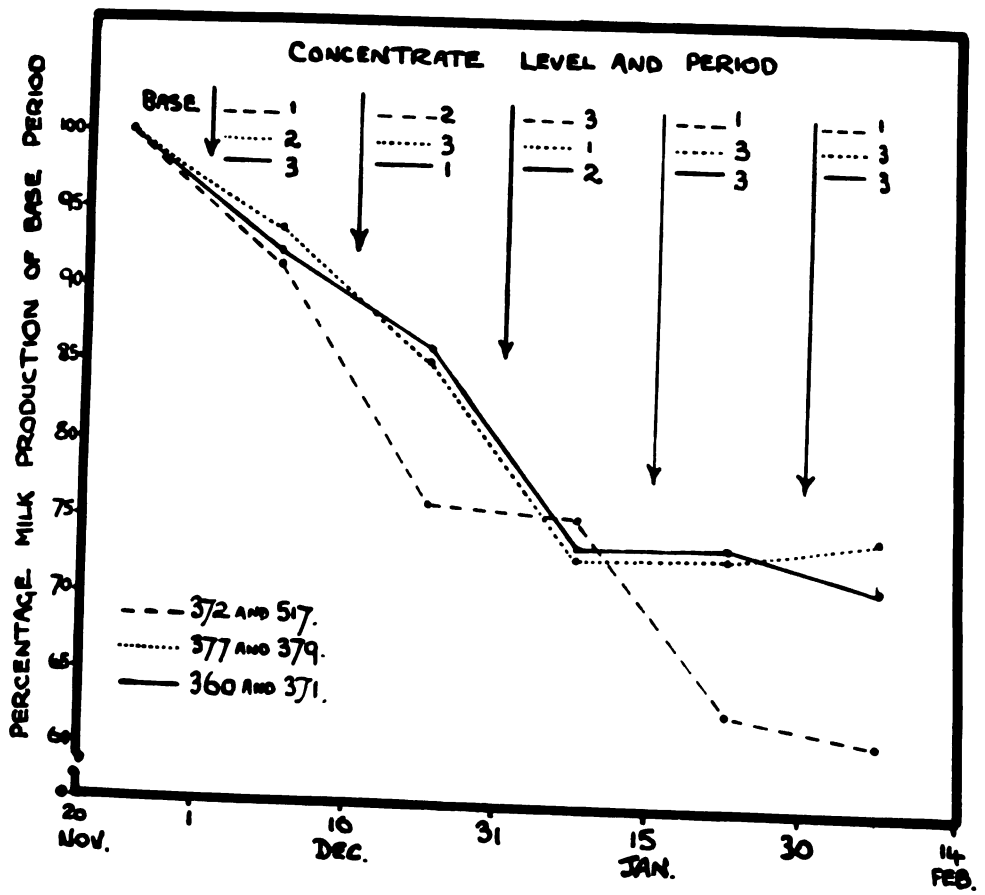

Figure 5. Effect on milk production of alternating group II animals between concentrate rates 1, 2, and 3. Periods were of 15-day duration.

making more use of the silage? Or was the 15-day period too short a time to give a good indication of what the cows would do? According to these results, it would seem that the cows in group II on silage and hay and rate 3 were, generally, more than able to maintain the normal lactation curve as illustrated by Turner (34) and Petersen (25).

No direct multicow comparison can be drawn from the first phase of five feeding periods between the hay group and the hay and silage group. While recognizing that it is dangerous, unreliable, and of little practical value to compare two cows, it is done in this case for lack of better. Cow number 350 in group I and cow number 360 in group II were as closely paired as could be hoped for. They both freshened in September, 1953, were served and settled within three weeks of each other, and at the beginning of the concentrate feeding study, 350 was producing 45.9 pounds of milk and 360 was producing 48.4 pounds of milk. The production of 350, after being on concentrate rates 3 and 4 for 60 days was 34.9 pounds, representing 76.0 percent of initial production. On the other hand, the production of 360 after the same length of time was 34.7 pounds, or 75.3 percent of initial production after being a quarter of the time on rate 2 and another quarter on rate 1.

The second phase, or the last two of the seven periods, was devoted to trying to get a comparison between the two groups. Figure 6 shows this graphically. Cow numbers 350 and 372 started the sixth period on hay and were transferred to silage and hay on the seventh period; cows 360 and 517 started on silage and hay and were changed to hay only; the remaining three cows, numbers 335, 371, and 379, were given silage and hay during both the periods. The concentrates were kept constant at rate 3 for the two periods. Figure 6 shows the production of 350 and 372 dropped by 9.8 percent when on hay, and then increased 0.4 percent when they were transferred on to silage and hay. When cows 360 and 517 went from silage and hay to hay, no difference was observed in the milk production trend from that of the contrals, numbers 335, 371, and 379, which remained on silage and hay.

From this work there is some indication that group I animals on hay alone required concentrate rate 4, which was approximately 1 pound for each 2 pounds of milk produced, to maintain a normal production curve. The production performance of group II animals on silage and hay showed that a similar production curve could be maintained on rate 3 or 1 pound for each 3 pounds of milk produced and, on occasion, there was a faint suggestion that probably 1 pound

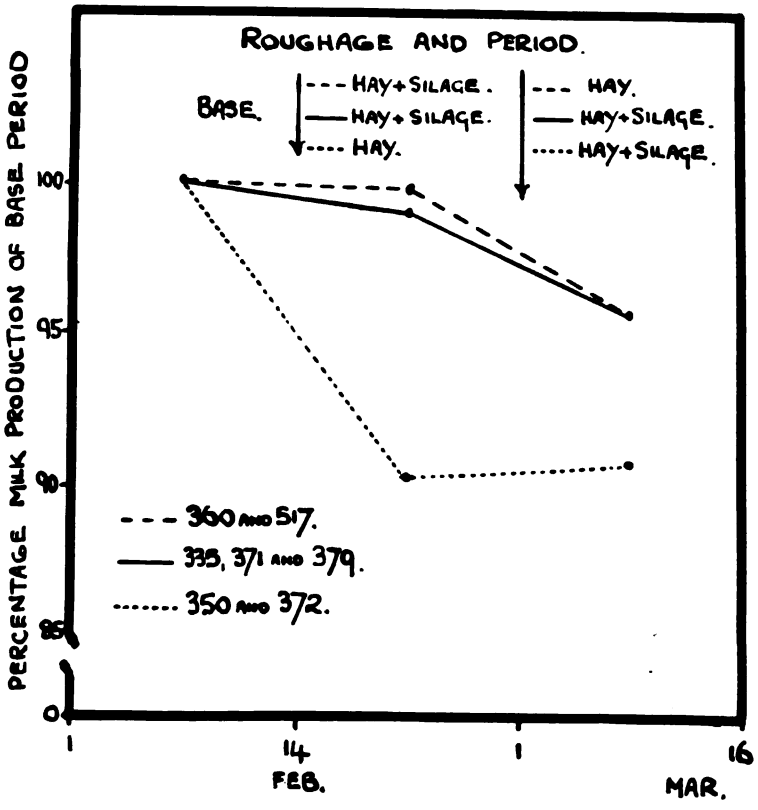

Figure 6. Effect on milk production of changing from hay alone to hay and silage and vice versa with concentrate rate constant. Periods were of 15-day duration.

for each 3.5 pounds was adequate. The T.D.N. intake from roughages for the silage-hay group would suggest that production should have been maintained on concentrate rate 2; however, this was not substantiated.

Body Weight

Appendix Tables XXVI, XXVII, XXVIII, XXIX, XXX, XXXI, XXXII, XXXIII, and XXXIV record the individual cow body weights for 3 consecutive days at approximately 2-week intervals throughout November, December, January, February, and March. In comparing the trends in body weights between the two groups, it was found that only two cows could be considered in group I and six cows in group II. The periods of comparison used were December, January, and February. The other cows were not included as they either had shown, during these three months, symptoms of acute mastitis or were four months or less from their next freshening date. Figure 7 compares graphically the group average body weights. No obvious difference was found.

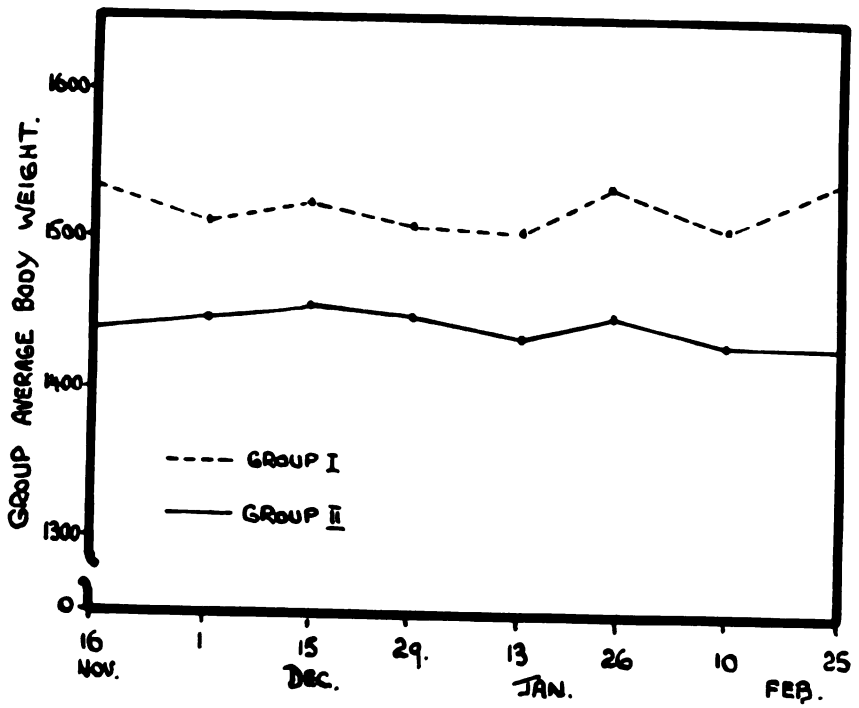

Figure 7. Average body weight of experimental animals in each group. Only body weights of apparently healthy animals which were 4 months or more away from their next calving date were used.

SUMMARY

By various feeding trials throughout the entire experimental period it was found that group I cows consumed an average of 22 pounds of alfalfa-brome hay per cow daily. Group II cows consumed per cow daily, an average of 58.6 pounds of corn silage and 7.0 pounds of alfalfa-brome hay. Theoretically, these two roughage rations should produce 3.65 and 19.03 pounds of milk respectively, as well as provide for body maintenance.

Group I animals, all of which were on hay alone, spent an average of 329 minutes, or 22.9 percent, of each 24-hour period eating hay showing a definite eating peak from 7:00 a.m. to 2:00 p.m. and again from 4:00 to 8:00 p.m. Group II animals spent, of each 24-hour period, an average of 68 minutes, or 4.8 percent, eating hay and 228 minutes, or 15.8 percent, eating silage. The hay eating time in this group was evenly distributed, but a definite preference was shown for eating silage between 7:00 a.m. and 7:00 p.m., and to a lesser extent, between 10:00 p.m. and 1:00 a.m.

The time spent loitering in the paved yard showed quite a difference between the two groups. Group I animals spent an average

of 138 minutes, or 9.5 percent, of each 24-hour period, whereas group II animals spent an average of 214 minutes, or 14.8 percent. Time spent eating and necessary management practice at milking are considered to account for the difference. The 5 percent difference in time spent by the groups loitering in the lounge can also be explained by the management routine at milking. The average time spent by the two groups resting in the lounge was similar.

It was not possible to differentiate between silage storage and feeding losses as previous work on storage losses give no guide as to the amount to allow for the self-feeding type silo used in this study. Of the 118.5 tons of crop silage filled, only 62.09 tons, or 52.4 percent, was calculated as having been fed; 30.02 tons, or 25.3 percent, was weighed as spoiled, and 26.39 tons, or 22.3 percent, unaccounted for.

Feed flavors were found to occur in the milk from the group on hay alone as well as from the group on silage and hay. Feed flavor occurred in 79 percent of the evening samples and in 21 percent of the morning samples.

This study indicates that economies can be made in feeding concentrates to animals on a silage-hay roughage ration as compared to animals on hay alone. Under the conditions of this experiment,

the animals on hay alone required concentrates at approximately 1 pound for each 2 pounds of milk produced to maintain a satisfactory lactation curve; the animals on silage and hay at no time required a ratio of more than approximately 1 pound for each 3 pounds of milk produced and performance, on occasion, faintly suggested that 1 pound for each 3.5 pounds of milk probably was sufficient.

No obvious difference between the groups was found on comparing the body weights of apparently healthy cows at least four months from next freshening.

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APPENDIX

TABLE XVIII

MILK SCORING GUIDE

General Rating	
Excellent	40-45
Good	37-40
Fair	34-37
Poor	25-34

Defect	Score	Defect	Score
Flat		Malty	
Slight	39.5	Slight	36
Distinct	38	Distinct	34
Strong	37	Strong	32
Cooked		Cowy	
Slight	39	Slight	36
Distinct	38	Distinct	34
Strong	37	Strong	32
Feed		Bitter	
Slight	39	Slight	36
Distinct	38	Distinct	34
Strong	35	Strong	32
Salty		Oxidized	
Slight	38	Slight	35
Distinct	36	Distinct	33
Strong	34	Strong	30
Metallic		Weedy	
Slight	36	Slight	35
Distinct	34	Distinct	33
Strong	32	Strong	30

TABLE XVIII--Continued

Defect	Score	Defect	Score
Musty		High Acid	
Slight	35	Slight	35
Distinct	33	Distinct	33
Strong	30	Strong	30
Unclean		Garlic-Onion	
Slight	35	Slight	35
Distinct	33	Distinct	33
Strong	30	Strong	30
Disinfectant		Rancid	
Slight	35	Slight	34
Distinct	33	Distinct	32
Strong	30	Strong	30

TABLE XIX

HERD ACTIVITY DATA[1]

Time of Day	Group I (9 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
12:10	2	2			5	
12:20	2	2			5	
12:30	1	2	1		5	
12:40	2	1			6	
12:50	1	2	1		5	
1:00	1	2	1		5	
1:10	1	1			7	
1:20	1				8	
1:30	1				8	
1:40	1		2		6	
1:50	1				8	
2:00		1			8	
2:10	1				8	
2:20	1				8	
2:30	1				8	
2:40			1		8	
2:50					9	
3:00					9	
3:10			1		8	
3:20	1		1		7	
3:30	2				7	
3:40	1		2		6	
3:50		1			8	
4:00	1		3		5	
4:10	1		2		6	
4:20	1		1		7	
4:30	1		1		7	

TABLE XIX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
	2	1			8	
	2	1			8	
1	3		1		6	
1	3				7	
1	3				7	
1	3				7	
1	2				8	
	2	1			8	
		1			10	
			2		9	
			1		10	
			4		7	
1	1	2			7	
2	1		1		7	
1	1	1	2		6	
	1		2		8	
		1	2		8	
1	1		2		7	
1	1		1		8	
1	2				8	
1	2				8	
	2		2		7	
	1		1		9	
	1				10	
	1				10	
					11	
					11	

TABLE XIX--Continued

Time of Day	Group I (9 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
4:40	1		1		7	
4:50	1		1		7	
5:00	1				8	
5:10			5			4
5:20			5			4
5:30			5			4
5:40			5			4
5:50	1	1	3		4	
6:00	2		3		4	
6:10	2		3		4	
6:20	3		3		3	
6:30	3				6	
6:40	2	1			6	
6:50	1	1			7	
7:00	2				7	
7:10	1		3		5	
7:20	1		3		5	
7:30	1		3		5	
7:40	1	3	2		3	
7:50		4	3		2	
8:00	1	3	3		2	
8:10	2	4	1		2	
8:20	1	4	2		2	
8:30	1	4	2		2	
8:40		5	2		2	
8:50		7			2	
9:00	4	1	3		1	
9:10	2	3	3		1	
9:20	5		3		1	
9:30	4	1	3		1	

TABLE XIX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
					11	
			1		10	
					11	
		11				
1	1	9				
1	1	9				
1	2	9				
		1	6			4
	1		6			4
	1	1	5			4
	2	1	4			4
	1	3	5			2
1	2	2	6			
1	2	1	3		4	
2	2		1		6	
	2	1	3		5	
	1	1	3		6	
	1	1			9	
	2	2			7	
	2	1	1		7	
	3		3		5	
	2	4	3		2	
	1	5	3		2	
	2	4	3		2	
	4	2	3		2	
	4	1	4		2	
	4	2	5			
	1	4	1		5	
	2	3	1		5	
	1	5	1		4	

TABLE XIX--Continued

Time of Day	Group I (9 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
9:40	5		3		1	
9:50	4	1	2		2	
10:00	4	2	1		2	
10:10	5	3			1	
10:20	3	3	3			
10:30	3	2	4			
10:40	4	1	3		1	
10:50	3	2	3		1	
11:00	4		4		1	
11:10	2	2	4		1	
11:20	2	4	1		2	
11:30	2	5	1		1	
11:40	4	1	2		2	
11:50	5	1			3	
12:00	5	1			3	
12:10	5		1		3	
12:20	5		1		3	
12:30	3	1	1		4	
12:40	1	3			5	
12:50	4	1			4	
1:00	1	3	1		4	
1:10	2	2	1		4	
1:20	2	2	2		3	
1:30	4		2		3	
1:40	4	1	1		3	
1:50	3	1	2		3	
2:00	3	1	2		3	
2:10	4		5			
2:20	3		6			
2:30	5		4			

TABLE XIX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
		5	2		4	
1	2		1		7	
	3	2	1		5	
2	1	2	5		1	
3	2	1			5	
	5	2			4	
	5	2			4	
1	6	-			4	
1	6	1			3	
2	4	2			3	
	6	2			3	
	2	2	4		3	
2	2	2	3		2	
	4	1	5		1	
	4		6		1	
1	2	2	4		2	
	3	2	4		2	
1	2	3	3		2	
2	3	1	1		4	
2	2		2		5	
1	4	1			5	
1	3	2			5	
1	4	2			4	
1	3		3		4	
1	3	2	2		3	
2	4		2		3	
1	3	1	3		3	
		4	5		2	
	1	2	6		2	
2	2	1	4		2	

TABLE XIX--Continued

Time of Day	Group I (9 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
2:40	2		7			
2:50	1	1	7			
3:00	1		8			
3:10	2	2	5			
3:20	1	2	4		2	
3:30	1	1	4		3	
3:40	2	1	3		3	
3:50	2		4		3	
4:00	2		4		3	
4:10	2	1	4		2	
4:20	2	1	4		2	
4:30	2		6		1	
4:40	2		5		2	
4:50			5			4
5:00	1		4			4
5:10	2		3			4
5:20	4	2				3
5:30	4	5				
5:40	6	3				
5:50	6	3				
6:00	5	1	3			
6:10	4		5			
6:20	4		5			
6:30	4		3		2	
6:40	2	2	3		2	
6:50	2	2	2		3	
7:00	3	1	2		3	
7:10	3		1		5	
7:20	2		2		5	
7:30	2		1		6	

TABLE XIX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
2	1	1	4		3	
3			5		3	
2	1		5		3	
1	2		5		3	
2	1		4		4	
1	2		3		5	
	3		3		5	
1	3	1	2		4	
1	3		2		5	
1	2		5		3	
1	2		6		2	
	3		5		3	
	3		5		3	
1	9	1				
	6	5	-			
2	3	6				
3	5	3				
1	1	2	3			4
1	1		5			4
1	1		5			4
1	1	1	4			4
	4		4			3
1	4	1	4		1	
2	4		3		2	
1	1		4		5	
1	1	1	2		6	
1	1		3		6	
			1		10	
					11	
					11	

TABLE XIX--Continued

Time of Day	Group I (9 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
7:40	2		1		6	
7:50	1		2		6	
8:00	1				8	
8:10	1				8	
8:20					9	
8:30					9	
8:40					9	
8:50					9	
9:00					9	
9:10					9	
9:20					9	
9:30	2		3		4	
9:40	3		2		4	
9:50	2		3		4	
10:00	2		2		5	
10:10	2		2		5	
10:20	1	1	1		6	
10:30	1	4			4	
10:40	1	4	1		3	
10:50	3	1	1		4	
11:00	1	3	1		4	
11:10	1	2	2		4	
11:20	3	1	2		3	
11:30	1	3	2		3	
11:40	3	1	1		4	
11:50	2	2			5	
12:00	3	1			5	

[1] 12:00 to 8:00 a.m., Dec. 22; 8:00 to 2:00 p.m., Dec. 26, and 2:00 to 12:00 p.m., Dec. 22, 1953.

TABLE XIX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
					11	
					11	
					11	
					11	
					11	
					11	
	1				10	
	1		2		8	
	1				10	
1					10	
2					9	
2	1				8	
1	2		2		6	
2	2		1		6	
1	1		2		7	
1			1		9	
-	1		1		9	
-	1	1			9	
1	1				9	
1	2		2		6	
1	1		4		5	
1	2		2		6	
1	2	2	2		4	
1	2		2		6	
	2	2			7	
	2	1			8	
	2	1			8	

TABLE XX

HERD ACTIVITY DATA[1]

Time of Day	Group I (8 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
12:10	1	1			6	
12:20	1	1			6	
12:30	2				6	
12:40	2				6	
12:50	1		1		6	
1:00	1		1		6	
1:10		1	1		6	
1:20	1				7	
1:30	1				7	
1:40	1				7	
1:50	1				7	
2:00	1				7	
2:10		1	1		6	
2:20	1		1		6	
2:30		1	3		4	
2:40			4		4	
2:50	1		4		3	
3:00	1		4		3	
3:10	2		2		4	
3:20	2		2		4	
3:30	2		1		5	
3:40	2		1		5	
3:50	2		1		5	
4:00	2		1		5	
4:10	1		2		5	
4:20	1		2		5	
4:30	1		2		5	

TABLE XX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
1	2	1			7	
	1	1	1		8	
	2				9	
	2		1		8	
	1		1		9	
	1		1		9	
	1				10	
	1		1		9	
	1				10	
1			1		9	
1			2		8	
1			1		9	
			1		10	
			1		10	
					11	
					11	
			6		5	
	1		1		9	
	1		1		9	
	1		1		9	
	1		1		9	
	1		1		9	
	2		1		8	
2					9	
	1		1		9	
	1				10	
	1				10	

TABLE XX--Continued

Time of Day	Group I (8 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
4:40	1		3		4	
4:50	1		3		4	
5:00	1		3		4	
5:10			4			4
5:20			4			4
5:30		2	3			3
5:40	2		6			
5:50	1	1	6			
6:00	3		3		2	
6:10	3		3		2	
6:20	3				5	
6:30	3				5	
6:40	2		1		5	
6:50	2		2		4	
7:00	2		1		5	
7:10	2	1	3		2	
7:20	2	2	2		2	
7:30	2	1	3		2	
7:40	3	1	2		2	
7:50	4	1			3	
8:00	2	2	2		2	
8:10	3	1	2		2	
8:20	2	1	3		2	
8:30	2	1	2		3	
8:40	2	1	3		2	
8:50	1	2	3		2	
9:00	1	1	4		2	
9:10	2	1	3		2	
9:20	3		2		3	
9:30	3		2		3	

TABLE XX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
			1		10	
			2		9	
			1		10	
	2	9				
1	2	8				
1	2	8				
1	1	9				
	2	1	2		2	4
	2		3		2	4
1	2	3	1			4
	3	6	2			
1	2	6	2			
	2	6	3			
	3	5	3			
	4	4	1		2	
1	3	3	3		1	
1	3	3	3		1	
1	4	2	1		3	
	5	1	2		3	
1	4	2			4	
	3	3	1		4	
	3	2	2		4	
	4		3		4	
1	3		3		4	
1	4		2		4	
1	3		3		4	
	2		4		5	
	1		4		6	
		1	2		8	
2	2				7	

TABLE XX--Continued

Time of Day	Group I (8 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
9:40	3	1	1		3	
9:50	3		2		3	
10:00	2		2		4	
10:10	2		2		4	
10:20	2		2		4	
10:30	1	1	4		2	
10:40	2		4		2	
10:50	2		4		2	
11:00	3	1	2		2	
11:10	3	1	2		2	
11:20	3		3		2	
11:30	3		3		2	
11:40	3		2		3	
11:50	3		2		3	
12:00	3		1		4	
12:10	3	2	1		3	
12:20	3	1	2		2	
12:30	4	2			2	
12:40	4	1	2		1	
12:50	5		2		1	
1:00	5	1	1		1	
1:10	3	2	2		1	
1:20	4	1	1		2	
1:30	2	2	1		3	
1:40	3	1			4	
1:50	2	2			4	
2:00	1	2	1		4	
2:10	1	2	1		4	
2:20	1	2	1		4	
2:30	1	2			5	

TABLE XX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
2	1	1			7	
2	2				7	
3	2		1		5	
3	2		2		4	
2	3		2		4	
1	3	2	2		3	
	4	2	2		3	
	4	1	3		3	
	3	1	3		4	
	3	2	3		3	
3	2	1	2		3	
1	1	4	2		3	
1	3		6		1	
1	2	1	5		2	
	3	1	2		5	
	2	2	1		6	
1	2	2	2		4	
	3	3			5	
2	2	2			5	
	2	4			5	
	1	5			5	
1	2	2	1		5	
	2	3	1		5	
	2	3	2		4	
	2	5	3		1	
	4	5	1		1	
1	5	4	1			
	5	5			1	
	6	3	1		1	
	1	8	1		1	

TABLE XX--Continued

Time of Day	Group I (8 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
2:40		3			5	
2:50		3			5	
3:00	1	2			5	
3:10		2	2		4	
3:20	2	3	3			
3:30	3	4	1			
3:40	3	3	1		1	
3:50	2	5			1	
4:00	1	6			1	
4:10	1	5	1		1	
4:20	1	6	1			
4:30	1	1	6			
4:40	3		1			4
4:50	3		1			4
5:00	2	1	2			3
5:10	3		4			1
5:20	4	1	2		1	
5:30	2	1	4		1	
5:40	2	1	4		1	
5:50	2		4		2	
6:00	3		3		2	
6:10	2	2	2		2	
6:20	2	1	3		2	
6:30	2	1	3		2	
6:40	2		3		3	
6:50	1		3		4	
7:00	1		2		5	
7:10	1		1		6	
7:20	1		1		6	
7:30	2				6	

TABLE XX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
	2	7	1		1	
	3	6	1		1	
	2	7			2	
	2	6	1		2	
	3	6			2	
	2	7	1		1	
1	1	7	1		1	
1	2	7			1	
1	2	7	1			
1	2	8				
1	3	7				
	6	5				
1	7	3				
1	7	3				
2	3	6				
1	4	6				
	3		4			4
	3		4			4
	3		4			4
	3	1	3			4
	1	5	2			3
	4	4	2		1	
	4	4	2		1	
1	5	3	1		1	
	3	2	5		1	
	5		4		2	
	4	2	3		2	
1	2				8	
1	2				8	
	3				8	

TABLE XX--Continued

Time of Day	Group I (8 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
7:40	2				6	
7:50	2				6	
8:00	2				6	
8:10	2				6	
8:20	2				6	
8:30	2				6	
8:40	2				6	
8:50		1	2		5	
9:00		1	2		5	
9:10	2	1	3		2	
9:20	3		3		2	
9:30	3				5	
9:40	2	1	3		2	
9:50	3	1	1		3	
10:00	3	1	1		3	
10:10	3	1			4	
10:20	3	1			4	
10:30	3	1	1		3	
10:40	3	1	1		3	
10:50	2	1	2		3	
11:00	2	1	3		2	
11:10	1	1	5		1	
11:20	1	1	4		2	
11:30	1	1	2		4	
11:40	1	1	1		5	
11:50	1	1			6	
12:00	1	1			6	

[1] 12:00 to 12 a.m., Jan. 2; and 12:00 to 12 p.m., Jan. 3, 1954.

TABLE XX--Continued

Group II (11 head)						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
	2				9	
					11	
					11	
					11	
					11	
1	1				9	
1	1				9	
1	1				9	
1	1		1		8	
1	2		2		6	
	2	2	1		6	
	3		1		7	
	1	2			8	
	1	1	1		8	
	1	1	1		8	
	2		5		4	
1		1	3		6	
1		2	1		7	
1		2			8	
	1	3	2		5	
	1	4	1		5	
1	1	3	2		4	
2	1	3	1		4	
1	2	3	2		3	
	3	1	2		5	
	4		3		4	
1	2	1	1		6	

TABLE XXI

HERD ACTIVITY DATA[1]

Time of Day	Group I (4 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
6:10	1	1	1		1	
6:20		1	1		2	
6:30		2	2			
6:40		1	2		1	
6:50	2		2			
7:00	2		2			
7:10	1	1	2			
7:20	1	1	2			
7:30	1	1	2			
7:40	1	1	2			
7:50	1		2		1	
8:00	1		2		1	
8:10	1		2		1	
8:20	1		1		2	
8:30	1		1		2	
8:40	1		1		2	
8:50			1		3	
9:00			1		3	
9:10			1		3	
9:20			1		3	
9:30					4	
9:40					4	
9:50					4	
10:00					4	
10:10					4	
10:20					4	
10:30			1		3	
10:40			1		3	

TABLE XXI--Continued

Group II (13 head)[2]						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
	4	3	5		1	
1	3	3	4		2	
	3	4	3		3	
1	5		4		3	
	1	4	1		7	
		4	1		7	
			5		8	
			5		8	
			4		9	
			4		9	
			3		10	
			3		10	
			4		9	
			1		12	
			2		11	
			1		12	
			1		12	
			1		12	
			1		12	
			2		11	
			1		12	
					13	
			4		9	
	1		4		8	
	2		3		8	
1	1		3		8	
	2		4		7	
	2		5		6	

TABLE XXI--Continued

Time of Day	Group I (4 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
10:50	1		1		2	
11:00	1				3	
11:10	2		2			
11:20	2		2			
11:30	2		1		1	
11:40	2		1		1	
11:50	2		1		1	
12:00	2		1		1	
12:10	2				2	
12:20	2				2	
12:30	1		1		2	
12:40	1		1		2	
12:50			2		2	
1:00			1		3	
1:10			1		3	
1:20			1		3	
1:30			1		3	
1:40					4	
1:50			1		3	
2:00					4	
2:10					4	
2:20					4	
2:30			1		3	
2:40			1		3	
2:50	1		2		1	
3:00	1		2		1	
3:10	1		2		1	
3:20	1		1		2	
3:30	1		1		2	
3:40	2		1		1	

TABLE XXI--Continued

Group II (13 head)[2]						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
2	3		5		3	
1	3		8		1	
1	2		9		1	
	2	3	8			
1	1	2	7		2	
1	1	2	7		2	
		1	9		3	
		1	8		4	
	1		8		4	
1	2		6		4	
	2	1	6		4	
	2	1	5		5	
	3		5		5	
	2	3	5		3	
	3	2	3		5	
	2	2	4		5	
	2	2	4		5	
	1	2	3		7	
	1	1	4		7	
		1	6		6	
			7		6	
			6		7	
	1		4		8	
	2		5		6	
	1	1	6		5	
	2		4		7	
	1		4		8	
1			4		8	
	1		4		8	
			5		8	

TABLE XXI--Continued

Time of Day	Group I (4 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
3:50	2		1		1	
4:00	1	1	1		1	
4:10	1		1		2	
4:20	1		1		2	
4:30			1		3	
4:40			1		3	
4:50			2		2	
5:00			2		2	
5:10			1			3
5:20			1			3
5:30			4			
5:40	1		3			
5:50	1		3			
6:00	1		2		1	
6:10	1		2		1	
6:20			2		2	
6:30			2		2	
6:40			2		2	
6:50			2		2	
7:00			1		3	
7:10					4	
7:20					4	
7:30					4	
7:40					4	
7:50	1				3	
8:00	1				3	
8:10	1		1		2	
8:20	2		2			
8:30	4					
8:40	4					

TABLE XXI--Continued

Group II (13 head)[2]						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
	1		4		8	
	1		5		7	
	1		4		8	
	1		4		8	
			1		12	
			1		12	
			5		8	
			6		7	
	1	12				
	2	11				
		1	8			4
1			8			4
			9			4
		1	8			4
		3	6			4
	2	3	5			3
1	2	5	4		1	
1	2	5	3		2	
	2	6	3		2	
1	2	5	2		3	
	1	5	3		4	
		3	4		6	
		3	2		8	
	1		5		7	
	2		4		7	
	2		4		7	
	2	1	9		1	
1	4		8			
2	3	1	7			
4	1	1	7			

TABLE XXI--Continued

Time of Day	Group I (4 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
8:50	3	1				
9:00	2	1	1			
9:10	2	1	1			
9:20	2		2			
9:30	2		2			
9:40	2		2			
9:50	2		2			
10:00	2		2			
10:10	2		2			
10:20	2		2			
10:30	2		2			
10:40	2		2			
10:50	2		2			
11:00	3		1			
11:10	3		1			
11:20	3		1			
11:30	3		1			
11:40	3				1	
11:50	3				1	
12:00	1	2			1	
12:10		3			1	
12:20		3			1	
12:30	3				1	
12:40	3				1	
12:50		2	1		1	
1:00			3		1	
1:10			3		1	
1:20			2		2	
1:30			3		1	
1:40			2		2	

TABLE XXI--Continued

Group II (13 head)[2]						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
3	3		7			
1	2	2	5		3	
		4	3		5	
	1	1	4		6	
	1		5		6	
	1	1	3		7	
	2		2		8	
	2		2		8	
		1	3		8	
		1	2		9	
		1	2		9	
		1	3		8	
1		1	3		7	
1		1	4		6	
	4	2	3		3	
1	4	1	4		2	
2	4	1	3		2	
1	4	2	3		2	
1	4	2	3		2	
1	1	6	2		2	
1	2	5	2		2	
1	2	5	2		2	
1	1	6	1		3	
1	1	6	1		3	
2	1	6	1		2	
2	2	4	2		2	
1	2	4	3		2	
	3	4	3		2	
3	3	1	3		2	
2	2	2	2		4	

TABLE XXI--Continued

Time of Day	Group I (4 head)					
	Number of Cows					
	Eating Hay	Loitering		Resting		In Milking Room
		Yard	Lounge	Yard	Lounge	
1:50			2		2	
2:00			2		2	
2:10			1		3	
2:20			1		3	
2:30			1		3	
2:40			1		3	
2:50			1		3	
3:00		1	1		2	
3:10	1		1		2	
3:20		1	1		2	
3:30			2		2	
3:40			2		2	
3:50		1	3			
4:00		1	3			
4:10			4			
4:20			4			
4:30		1	3			
4:40		1				3
4:50	1					3
5:00	3	1				
5:10	2	1	1			
5:20	1	1			2	
5:30	1	2			1	
5:40	1	2			1	
5:50	1	2			1	
6:00	1	2			1	

[1] 6:00 p.m., Feb. 5, to 6:00 p.m., Feb. 6, 1954.

[2] Cow in heat. Put in Box Stall at 9:00 a.m.

TABLE XXI--Continued

Group II (13 head)[2]						
Number of Cows						
Eating		Loitering		Resting		In Milking Room
Hay	Silage	Yard	Lounge	Yard	Lounge	
2	2	2	2		4	
	2	4	2		4	
	3	1	2		6	
	3	1	2		6	
	2	1	3		6	
	2	2	3		5	
1	2	1	3		5	
1	2	1	4		4	
1	3	1	3		4	
	3	1	4		4	
	3	1	5		3	
I	4	2	2		3	
	5	1	3		3	
1	3	4	2		2	
1	3	8				
1	3	8				
3		9				
3	2	7				
1	5	6				
			8			4
			8			4
1		5	2			4
		3	3		2	4
		4	5			3
	3	7	2			
1	1	7	3			

TABLE XXII

COW DAYS EATING HAY AND SILAGE AND HAY

Date	No. of Days	Group I		Group II	
		No. of Cows	No. of Cow Days	No. of Cows	No. of Cow Days
Oct. 23-31, 1953	9	-	-	23	207
Nov. 1-5, 1953	5	-	-	23	115
Nov. 6-30, 1953	25	9	225	14	350
Dec. 1-5, 1953	5	9	45	14	70
Dec. 6-12, 1953	7	9	63	13	91
Dec. 13-20, 1953	8	9	72	12	96
Dec. 21-29, 1953	9	9	81	11	99
Dec. 30, 1953-Jan. 2, 1954	4	9	36	10	40
Jan. 3-5, 1954	3	9	27	11	33
Jan. 6-22, 1954	17	9	153	12	204
Jan. 23-30, 1954	8	9	72	12	96
Jan. 31-Feb. 5, 1954	6	7	42	14	84
Feb. 6-10, 1954	5	6	30	13	65
Feb. 11-14, 1954	4	7	28	13	52
Feb. 15-Mar. 10, 1954	24	9	216	11	264
Mar. 11-16, 1954	6	9	54	10	60
			1,144		1,926
Mar. 17-22, 1954	6	9	54	10	60
Mar. 23-Apr. 1, 1954	10	9	90	9	90
			144		150
TOTAL			1,288		2,076

TABLE XXIII

POUNDS OF SILAGE HAULED FROM SILO

Date	Reason for Removal	Pounds Spoiled Silage	Pounds Edible Silage
10/23/53	Opening silo - spoiled	1,775	-
11/4/53	Opening silo - spoiled	2,150	-
11/12/53	Excess - fed to other cattle	-	2,800
11/16/53	Residue from feeding trial - fed to other stock	-	520
11/22/53	Residue from feeding trial - fed to other stock	-	150
12/14/53	Moldy and spoiled	1,000	-
12/18/53	Moldy and spoiled	1,250	-
12/18/53	Residue from abandoned feeding trial - fed to other stock	-	120
12/28/53	Residue from feeding trial - fed to other stock	-	260
1/4/54	Moldy and spoiled	1,750	-
1/23/54	Residue from feeding trial - fed to other stock	-	409
1/24/54	Residue from feeding trial - fed to other stock	-	285
1/29/54	Moldy and frozen	2,250	-
2/14/54	Moldy and frozen	4,600	-
2/23/54	Moldy and frozen	4,526	-
3/8/54	Moldy and spoiled	5,850	-
3/22/54	Moldy and spoiled	2,825	-
3/22/54	Moldy and spoiled	3,975	-
3/22/54	Moldy and spoiled	3,390	-
3/24/54	Moldy and spoiled	3,050	-
3/24/54	Moldy and spoiled	3,000	-
3/25/54	Residue from feeding trial - fed to other stock	-	402
3/25/54	Residue from feeding trial - fed to other stock	-	415

TABLE XXIII--Continued

Date	Reason for Removal	Pounds Spoiled Silage	Pounds Edible Silage
4/1/54	Emptying of silo - spoiled	3,550	-
4/1/54	Emptying of silo - spoiled	4,750	-
4/1/54	Emptying of silo - spoiled	5,050	-
4/1/54	Emptying of silo - spoiled	5,300	-
	TOTALS	60,041	5,361

TABLE XXIV

POUNDS OF MILK PRODUCED BY THREE DAY AVERAGES

Date	Herd Number										
	322	335	350	360	365	367	369	371	372	377	379
					1953						
2 Oct.	29.1	Dry	49.9	52.9	34.8	53.3	3.3	33.2	24.5	19.9	41.6
5 Oct.	31.7		48.4	54.3	34.2	53.0	Dry	28.4	20.3	19.8	42.6
8 Oct.	28.9		49.0	52.9	31.5	51.6		25.2	18.9	17.6	40.0
11 Oct.	29.6		54.9	54.3	33.2	52.6		26.5	21.6	19.3	40.7
14 Oct.	31.2		53.3	57.9	34.5	53.8		30.9	22.6	19.9	41.3
17 Oct.	28.6		52.9	58.6	35.2	54.6		28.8	22.0	20.5	41.8
20 Oct.	27.1		49.1	53.6	34.3	55.5		27.6	20.8	18.6	39.8
23 Oct.	24.2		52.1	50.3	33.0	53.9		27.1	21.2	18.1	39.6
26 Oct.	26.1		52.7	50.5	34.0	56.9		25.5	21.6	19.1	39.9
29 Oct.	24.5		50.4	53.6	33.0	51.5		26.1	20.3	19.4	39.6
1 Nov.	23.9		44.9	47.8	32.7	50.6		25.9	20.3	19.3	38.3
4 Nov.	21.8		49.8	52.9	29.9	47.7		23.9	17.8	16.5	37.6
7 Nov.	17.5		47.2	53.7	30.5	44.6		24.2	17.3	16.3	38.3
10 Nov.	20.6		48.4	52.8	27.5	44.1		23.7	17.1	16.2	37.9
13 Nov.	19.9		49.9	53.3	28.8	46.5		22.6	17.9	14.7	38.0
16 Nov.	16.5		50.7	53.7	27.4	44.7		21.1	16.4	14.4	35.1
19 Nov.	12.2		46.0	47.0	26.2	42.9		16.5	15.0	12.9	34.7
22 Nov.	7.5		43.9	43.8	26.2	43.0		18.3	15.6	13.2	36.3
25 Nov.	6.1		49.1	50.9	23.2	41.3		17.5	15.3	13.4	35.3
28 Nov.	Dry	54.4	45.5	53.2	24.5	43.5		17.1	15.3	14.2	33.3
1 Dec.		57.2	45.3	47.1	23.6	45.0		17.0	14.8	12.9	36.0
4 Dec.		59.2	45.9	44.8	24.7	43.7		18.3	15.3	12.4	36.9
7 Dec.		61.7	46.7	42.3	24.9	44.3		17.4	15.3	11.9	34.9
10 Dec.		63.7	43.8	42.9	24.1	43.3		17.8	15.4	11.8	33.5
13 Dec.		65.9	44.0	43.8	23.4	40.8		17.5	14.7	13.0	33.1
16 Dec.		63.3	40.5	41.7	23.7	39.5		15.8	12.1	8.2	31.4
19 Dec.		62.8	42.2	42.3	21.6	41.4		15.6	12.1	9.5	31.9
22 Dec.		62.1	41.3	42.7	21.4	42.4		13.3	7.7	8.6	31.4
25 Dec.		63.7	40.3	42.0	19.9	42.3		15.9	12.4	10.2	32.1
28 Dec.		64.6	41.2	41.2	20.1	42.9		15.9	11.6	10.3	31.5
31 Dec.		59.0	39.9	38.6	18.9	41.6		14.6	12.9	9.9	31.5

TABLE XXIV--Continued

Herd Number											
389	466	490	496	503	517	520	521	523	525	531	533
					1953						
27.6	64.9	Dry	Dry	72.5	56.3	Dry	14.2	50.1	32.1	24.9	25.0
25.7	62.2			74.3	51.8		11.5	52.4	31.4	22.2	31.4
25.0	55.8			65.8	45.5	40.0	8.9	43.9	31.9	16.0	29.1
25.0	59.6			63.3	48.3	40.0	10.2	46.2	29.3	20.3	31.9
24.6	62.2			62.8	49.3	45.8	7.9	51.5	31.1	20.8	32.7
28.6	62.1			70.9	49.8	48.3	Dry	48.5	34.2	22.1	31.3
23.4	59.2			71.6	48.6	42.5		48.8	32.2	20.3	31.8
22.2	59.8			69.9	47.3	50.8		50.2	30.3	20.4	30.9
23.5	61.1			72.1	46.0	53.9		50.9	30.8	19.8	28.0
22.6	62.4			73.9	48.4	52.5		50.7	30.2	20.7	31.5
20.4	60.6			67.8	46.4	50.0		50.6	28.5	20.9	30.5
18.5	61.9			66.1	44.6	38.6		46.5	27.7	21.2	26.3
18.0	62.2			67.0	43.3	48.2		46.3	26.0	18.3	28.3
16.8	58.7	50.7		63.2	43.5	48.3		40.5	27.2	16.8	28.0
16.0	54.6	48.1		61.7	43.9	50.1		46.2	27.8	17.7	25.1
14.1	53.3	55.5		63.1	42.9	47.3		44.9	25.8	16.3	24.8
11.9	51.3	58.7		63.2	42.8	45.5		42.0	22.9	12.1	24.1
10.9	58.6	60.9		64.3	42.7	47.0		47.0	21.7	12.6	21.9
10.4	56.4	59.0		61.7	40.4	47.0		43.9	14.0	11.8	19.7
9.3	55.1	62.0		62.1	40.5	38.7		42.3	4.0	12.3	19.2
9.1	58.3	67.1		61.3	40.9	41.7		41.6	Dry	12.2	18.5
8.8	59.9	69.5		59.6	40.8	40.7		38.2		10.9	17.8
8.3	53.6	67.9		62.9	39.9	20.2		37.6		Dry	15.1
7.4	53.4	68.4		64.5	38.2	11.2		41.7			16.9
7.9	53.3	66.9		64.4	36.8	4.8		38.9			13.3
4.4	49.7	59.2		61.8	31.4	*		35.6			Dry
5.0	46.9	54.0		57.5	31.0			31.1			
5.4	44.3	48.3		60.2	34.8			29.9			
4.3	46.1	56.4		58.4	33.0			28.4			
3.4	45.8	52.1		56.9	30.9			26.7			
Dry	49.4	46.7	47.1	60.7	30.7			24.8			

TABLE XXIV--Continued

Date	Herd Number										
	322	335	350	360	365	367	369	371	372	377	379
					1954						
3 Jan.		63.0	39.5	33.3	18.9	40.6		13.8	12.8	9.5	28.8
6 Jan.		62.3	37.3	34.9	19.6	41.6		13.7	11.5	10.1	27.0
9 Jan.		62.1	37.2	35.5	19.3	41.1		13.5	12.1	9.7	26.2
12 Jan.		61.7	37.4	33.8	17.8	37.5	57.8	13.0	9.7	7.5	25.0
15 Jan.		58.7	33.1	34.8	16.2	38.1	58.6	13.8	10.5	7.5	25.0
18 Jan.		56.0	35.1	33.2	14.2	40.9	58.6	13.0	10.0	7.3	25.6
21 Jan.		57.7	35.8	34.7	14.8	41.2	56.1	13.6	10.8	7.3	27.3
24 Jan.		55.2	35.3	35.2	15.0	41.5	56.7	13.8	9.7	8.1	29.3
27 Jan.		58.9	34.6	35.4	12.1	40.8	63.1	13.5	10.2	7.7	28.2
30 Jan.		56.3	33.8	35.1	11.1	36.4	61.9	12.8	10.3	6.9	28.5
2 Feb.		56.5	34.5	34.9	9.8	17.1	54.9	12.5	10.5	6.1	29.2
5 Feb.		55.5	34.9	34.9	11.7		59.3	13.0	9.5	6.5	29.9
8 Feb.		54.6	33.1	34.4	12.8		59.9	12.5	9.9	8.0	28.5
11 Feb.		55.7	31.1	34.2	11.1	26.1	57.1	10.8	9.9	6.3	28.3
14 Feb.		55.2	31.8	33.9	9.8	31.6	59.9	11.4	9.4	5.9	30.7
17 Feb.		55.1	31.4	34.2	Dry	33.8	61.7	12.1	9.1	5.9	29.5
20 Feb.		57.0	31.5	34.9		34.8	60.6	10.9	8.4	6.6	28.2
23 Feb.		57.7	30.6	34.8		32.6	51.7	12.0	8.2	5.8	28.2
26 Feb.		55.9	30.8	32.3		31.4	52.3	12.3	7.2	5.4	27.6
1 Mar.		51.7	30.0	32.9		33.4	44.5	12.5	6.6	5.6	28.9
4 Mar.		53.4	29.5	31.7		33.5	46.6	12.1	8.1	6.9	29.4
7 Mar.	42.5	54.5	31.1	32.5		32.4	47.4	11.9	8.3	6.6	27.5
10 Mar.	46.3	53.9	30.0	32.1		32.9	44.9	11.8	9.7	6.9	26.7
13 Mar.	44.4	51.8	31.9	33.4		36.0	49.0	10.6	7.8	5.4	27.0
16 Mar.	44.5	53.1	32.0	32.5		32.9	47.1	10.9	6.2	5.8	28.5
19 Mar.	48.4	52.1	31.1	33.7		32.1	42.1	11.6	7.6	5.6	30.1

* Removed from herd and experiment.

TABLE XXIV--Continued

Herd Number											
389	466	490	496	503	517	520	521	523	525	531	533
					1954						
*	*	50.4	49.7	62.1	32.5			24.6			
		50.7	55.1	58.7	33.6			22.4			
		53.1	54.5	54.4	31.0			21.6			
		49.4	50.2	55.9	29.3			17.0			
		53.1	50.0	58.5	30.9			11.9			
		53.9	55.4	54.5	25.7			Dry			
		53.3	56.6	55.1	25.4						
		55.2	57.4	54.2	25.6						
		50.2	58.0	54.7	25.0				54.7		
		53.9	55.2	56.3	24.9				55.6		
		53.4	53.8	55.9	25.4				56.0		
		55.4	54.2	56.3	26.4				58.3		36.4
		51.5	54.4	53.1	24.6				61.5	55.5	45.8
		48.7	53.2	53.1	23.2		49.5		59.1	63.4	39.8
		52.2	55.8	52.5	23.9		52.9		59.2	62.7	48.6
		50.0	56.5	52.5	24.3		49.2		60.6	68.9	48.3
		49.3	59.2	54.5	24.7		52.5		64.6	77.2	40.2
		51.5	55.9	53.8	26.0		55.9		62.3	70.8	46.5
		54.9	55.9	45.5	26.2		56.4		62.7	74.8	52.3
		52.0	53.6	51.3	25.5		55.3		61.4	72.1	53.1
		52.5	52.4	51.9	24.7		55.8		57.2	73.1	54.6
		53.3	53.2	52.9	25.4		58.2		58.2	66.6	55.5
		49.1	52.3	52.0	25.2		48.8	Died	59.9	72.9	57.8
		50.5	51.2	51.7	23.6		41.6	-	54.3	73.8	52.6
		51.7	51.6	51.5	22.9		47.5	-	57.2	66.9	55.2
		47.6	49.3	52.9	24.6		47.1	-	60.7	71.6	56.8

TABLE XXV

POUNDS OF MILK PRODUCED BY FIFTEEN DAY AVERAGES

Date	Herd Number										
	322	335	350	360	365	367	369	371	372	377	379
					1953						
Nov. 1	25.2		49.8	51.1	33.4	53.7		26.4	20.8	18.9	39.4
Nov. 16	19.3		49.2	53.3	28.8	45.5		23.1	17.3	15.6	37.4
Dec. 1	8.5		45.9	48.4	24.7	43.1		17.3	15.2	13.3	35.1
Dec. 16		62.7	44.2	43.1	24.2	42.3		17.4	14.2	11.5	33.9
Dec. 31		62.4	40.9	41.4	20.4	42.1		15.1	11.3	9.7	31.7
					1954						
Jan. 15		61.2	36.9	34.5	18.4	39.8		13.5	11.3	8.8	26.4
Jan. 30		56.8	34.9	34.7	13.4	40.1	59.3	13.5	10.2	7.4	27.8
Feb. 14		55.5	33.1	34.5	11.0	Sick	58.2	12.0	9.8	6.5	29.3
Mar. 1		55.5	30.8	33.8	Dry	33.2	54.2	11.9	7.9	5.8	28.5
Mar. 16	44.4	53.3	30.9	32.4		33.9	47.0	11.5	8.0	6.3	27.8

* Removed from herd and experiment.

TABLE XXV--Continued

Herd Number											
389	466	490	496	503	517	520	521	523	525	531	533
					1953						
22.4	60.6			71.0	47.3	49.9		50.2	30.4	20.4	30.5
16.7	58.2			64.2	43.6	46.5		44.9	26.9	18.1	26.5
10.3	55.9	61.5		62.5	41.5	43.9		43.3	15.8	12.2	20.7
7.4	53.9	66.3		62.2	37.8	19.2		38.4		10.9	15.8
4.5	46.5	51.5		58.7	32.1	*		28.2			
					1954						
Dry	*	51.3	51.9	57.9	31.4			19.5			
		53.3	56.5	54.9	25.3				55.2		
		52.2	54.3	54.2	24.7				58.8		
*		51.5	56.2	51.5	25.3		53.8		62.3	72.7	48.1
		51.4	52.1	52.0	24.3		50.4		57.4	70.7	55.1

TABLE XXVI

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		11/15/53 (lbs.)	11/16/53 (lbs.)	11/17/53 (lbs.)	
I	322	1,413	1,450	1,456	1,439
	350	1,518	1,494	1,494	1,502
	365	1,494	1,524	1,514	1,511
	367	1,442	1,448	1,476	1,455
	369	1,604	1,602	1,604	1,603
	490	1,498	1,492	1,484	1,491
	503	1,374	1,384	1,384	1,381
	521	1,415	1,415	1,408	1,413
	531	1,414	1,396	1,402	1,404
II	335	1,804	1,804	1,786	1,798
	360	1,410	1,398	1,408	1,405
	371	1,622	1,666	1,636	1,641
	372	1,656	1,672	1,658	1,662
	377	1,472	1,500	1,496	1,489
	379	1,326	1,364	1,354	1,348
	389	1,366	1,372	1,336	1,358
	466	1,360	1,376	1,420	1,385
	496	1,610	1,626	1,588	1,608
	517	1,378	1,330	1,372	1,360
	520	1,400	1,384	1,416	1,400
	523	1,198	1,214	1,210	1,207
	525	1,476	1,478	1,456	1,470
	533	1,511	1,504	1,522	1,512

TABLE XXVII

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		11/30/53 (lbs.)	12/1/53 (lbs.)	12/2/53 (lbs.)	
I	322	1,506	1,508	1,524	1,513
	350	1,496	1,528	1,528	1,517
	365	1,506	1,508	1,552	1,522
	367	1,494	1,466	1,464	1,475
	369	1,692	1,688	1,690	1,690
	490	1,496	1,488	1,488	1,491
	503	1,386	1,386	1,360	1,377
	521	1,456	1,456	1,454	1,455
	531	1,436	1,410	1,438	1,428
II	335	1,689	1,670	1,694	1,684
	360	1,362	1,368	1,388	1,373
	371	1,630	1,644	1,656	1,643
	372	1,678	1,672	1,690	1,680
	377	1,522	1,534	1,552	1,536
	379	1,348	1,308	1,328	1,328
	389	1,399	1,388	1,370	1,386
	466	1,416	1,366	1,366	1,383
	496	1,638	1,680	1,652	1,657
	517	1,334	1,364	1,376	1,358
	520	1,376	1,394	1,376	1,382
	523	1,236	1,258	1,212	1,235
	525	1,482	1,514	1,516	1,504
	533	1,526	1,556	1,562	1,548

TABLE XXVIII

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		12/14/53 (lbs.)	12/15/53 (lbs.)	12/16/53 (lbs.)	
I	322	1,508	1,538	1,532	1,526
	350	1,542	1,532	1,532	1,535
	365	1,536	1,548	1,558	1,547
	367	1,496	1,466	1,458	1,473
	369	1,684	1,682	1,690	1,685
	490	1,464	1,466	1,468	1,466
	503	1,368	1,380	1,376	1,375
	521	1,454	1,468	1,472	1,465
	531	1,458	1,446	1,428	1,444
II	335	1,626	1,634	1,638	1,633
	360	1,370	1,388	1,378	1,378
	371	1,686	1,698	1,650	1,678
	372	1,702	1,690	1,698	1,697
	377	1,572	1,562	1,562	1,565
	379	1,338	1,348	1,332	1,339
	389	1,412	1,404	1,432	1,416
	466	1,412	1,358	1,384	1,385
	496	1,642	1,652	1,630	1,641
	517	1,438	1,410	1,406	1,418
	523	1,272	1,264	1,242	1,259
	525	1,578	1,570	1,542	1,563
	533	1,606	1,580	1,588	1,591

TABLE XXIX

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		12/28/53 (lbs.)	12/29/53 (lbs.)	12/30/53 (lbs.)	
I	322	1,562	1,558	1,546	1,555
	350	1,552	1,504	1,562	1,539
	365	1,550	1,494	1,504	1,499
	367	1,476	1,482	1,496	1,485
	369	1,622	1,634	1,624	1,627
	490	1,434	1,434	1,402	1,423
	503	1,368	1,360	1,350	1,359
	521	1,482	1,482	1,468	1,477
	531	1,470	1,452	1,458	1,460
II	335	1,612	1,602	1,562	1,592
	360	1,338	1,390	1,380	1,369
	371	1,650	1,692	1,682	1,675
	372	1,664	1,722	1,712	1,699
	377	1,552	1,622	1,582	1,585
	379	1,330	1,376	1,364	1,357
	389	1,420	1,422	1,446	1,429
	466	1,388	1,400	1,386	1,391
	517	1,352	1,368	1,378	1,366
	523	1,240	1,232	1,242	1,238
	525	1,576	1,610	1,602	1,596
	533	1,596	1,590	1,614	1,600

TABLE XXX

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		1/12/54 (lbs.)	1/13/54 (lbs.)	1/14/54 (lbs.)	
I	322	1,544	1,552	1,542	1,546
	350	1,502	1,530	1,494	1,509
	365	1,532	1,528	1,530	1,530
	367	1,436	1,462	1,464	1,454
	369	1,436	1,426	1,408	1,423
	490	1,396	1,392	1,394	1,394
	503	1,336	1,386	1,364	1,362
	521	1,482	1,490	1,472	1,481
	531	1,460	1,472	1,458	1,463
II	335	1,564	1,602	1,594	1,586
	360	1,322	1,356	1,364	1,347
	371	1,652	1,694	1,668	1,671
	372	1,678	1,732	1,704	1,705
	377	1,570	1,632	1,612	1,605
	379	1,308	1,356	1,318	1,327
	389	1,438	1,464	1,446	1,449
	496	1,292	1,338	1,326	1,319
	517	1,364	1,408	1,408	1,393
	523	1,232	1,286	1,248	1,255
	525	1,592	1,644	1,620	1,619
	533	1,614	1,664	1,652	1,643

TABLE XXXI

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number	Date			Three Day Average (lbs.)
		1/25/54 (lbs.)	1/26/54 (lbs.)	1/27/54 (lbs.)	
I	322	1,574	1,578	1,578	1,576
	350	1,552	1,532	1,538	1,541
	365	1,504	1,526	1,536	1,522
	367	1,508	1,504	1,510	1,507
	369	1,404	1,408	1,446	1,419
	490	1,484	1,502	1,488	1,491
	503	1,352	1,368	1,360	1,360
	521	1,502	1,514	1,500	1,505
	531	1,494	1,494	1.516	1,501
II	335	1,614	1,592	1,666	1,624
	360	1,334	1,378	1,384	1,365
	371	1,708	1,730	1,720	1,719
	372	1,702	1,748	1,762	1,737
	377	1,608	1,622	1,640	1,623
	379	1,350	1,362	1,344	1,352
	389	1,442	1,474	1,444	1,453
	496	1,330	1,332	1,316	1,326
	517	1,428	1,402	1,430	1,420
	523	1,268	1,312	1,308	1,296
	525	1,490	1,482	1,482	1,485
	533	1,660	1,668	1,676	1,668

TABLE XXXII

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number[1]	Date			Three Day Average (lbs.)
		2/9/54 (lbs.)	2/10/54 (lbs.)	2/11/54 (lbs.)	
I	322	1,592	1,546	1,560	1,566
	350	1,520	1,512	1,550	1,527
	369	1,446	1,430	1,462	1,446
	490	1,502	1,506	1,480	1,496
	521	1,214	1,230	1,226	1,223
	531	1,362	1,370	1,362	1,365
II	335	1,560	1,570	1,588	1,573
	360	1,342	1,328	1,350	1,340
	365	1,530	1,542	1,554	1,542
	371	1,710	1,698	1,694	1,701
	372	1,700	1,700	1,722	1,707
	377	1,630	1,612	1,658	1,633
	379	1,328	1,333	1,340	1,334
	496	1,358	1,368	1,300	1,342
	503	1,310	1,344	1,348	1,334
	517	1,402	1,384	1,398	1,395
	523	1,308	1,294	1,300	1,301
	525	1,410	1,432	1,410	1,417
	533	1,462	1,456	1,436	1,451

[1] Numbers 365 and 503 transferred to Group II, January 30, 1954.

TABLE XXXIII

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number[1]	Date			Three Day Average (lbs.)
		2/24/54 (lbs.)	2/25/54 (lbs.)	2/26/54 (lbs.)	
I	322	1,560	1,532	1,550	1,547
	350	1,535	1,512	1,500	1,516
	367	1,420	1,430	1,438	1,429
	369	1,470	1,428	1,424	1,441
	372	1,710	1,718	1,732	1,720
	490	1,516	1,520	1,522	1,519
	503	1,338	1,372	1,320	1,343
	521	1,190	1,176	1,186	1,184
	531	1,358	1,326	1,324	1,336
II	335	1,585	1,588	1,588	1,587
	360	1,360	1,364	1,362	1,362
	365	1,610	1,600	1,598	1,603
	371	1,780	1,762	1,742	1,761
	377	1,660	1,670	1,680	1,670
	379	1,360	1,342	1,360	1,354
	496	1,400	1,430	1,412	1,414
	517	1,430	1,432	1,430	1,431
	523	1,340	1,360	1,348	1,349
	525	1,415	1,425	1,410	1,416
	533	1,410	1,445	1,420	1,425

[1] Numbers 372 and 503 transferred to Group I, February 14, 1954.

TABLE XXXIV

BODY WEIGHTS OF EXPERIMENTAL ANIMALS

Group	Herd Number[1]	Date			Three Day Average (lbs.)
		3/16/54 (lbs.)	3/17/54 (lbs.)	3/18/54 (lbs.)	
I	322	1,440	1,445	1,400	1,428
	360	1,376	1,372	1,398	1,382
	367	1,452	1,482	1,484	1,473
	369	1,446	1,440	1,436	1,441
	490	1,552	1,584	1,508	1,548
	503	1,318	1,370	1,356	1,348
	517	1,378	1,430	1,412	1,407
	521	1,138	1,182	1,122	1,147
	531	1,334	1,364	1,356	1,351
II	335	1,612	1,664	1,618	1,631
	350	1,584	1,592	1,570	1,582
	365	1,682	1,670	1,710	1,687
	371	1,798	1,820	1,816	1,811
	372	1,786	1,790	1,802	1,793
	377	1,698	1,704	1,698	1,700
	379	1,358	1,368	1,360	1,362
	496	1,450	1,458	1,434	1,447
	523	-	-	-	-
	525	1,434	1,436	1,446	1,439
	533	1,440	1,432	1,396	1,423

[1] Numbers 350 and 372 transferred from Group I to II, and Numbers 360 and 517 from Group II to I, on March 1, 1954.

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